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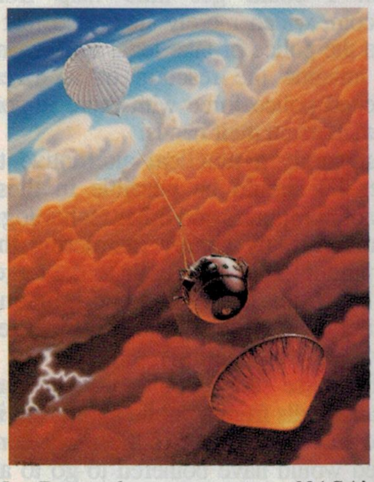
Volume 55, No.5

# Electronics Australia WITH eti

May 1993

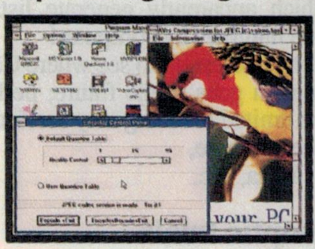
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

**Long voyage to Jupiter**



*In December next year, NASA's Galileo space probe should reach Jupiter and enter that planet's atmosphere. It will be the culmination of a long and arduous journey (most of it on Earth), as Kate Doolan explains in her story starting on page 26...*

**Compressing images...**



*AVer's JPEG card for PC's can compress many different kinds of image file, by factors of between 1 and 99. See Computer News, page 126.*

**On the cover**

*Scientific-Atlanta's Australian MD Mr Steve Dean, holding an MPEG decoder card, points out features of the decoded video during S-A's recent demonstrations of its compressed digital video system for Pay-TV. See our news story on page 106. (Courtesy Scientific Atlanta.)*

## Video and Audio



## Features



## Projects and Technical



## Professional Electronics



## Columns and Comments



## Departments

**MANAGING EDITOR**
Jamieson Rowe, B.A., B.Sc., SMIREE, VK2ZLO
**FEATURES EDITOR**
Peter Murtagh, B.Sc, Dip.Ed.
**TECHNICAL EDITOR**
Rob Evans, CET (RMIT)
**TECHNICAL CONSULTANT**
Peter Phillips, B.Ed., Dip Ed., ECC
**CONTRIBUTORS**
Neville Williams, FIREE, VK2XV
Jim Lawler, MTETIA
Arthur Cushen, MBE
Tom Moffat, VK7TM
Peter Lankshear
Louis Challis
Major Al Younger (USAR, Ret.)
**SECRETARY**
Ana Maria Zamora
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**COVER DESIGNER**
Clive Davis
**PRODUCTION**
Patrice Wohlnick, Mal Burgess
**ADVERTISING PRODUCTION**
Anthony Macarounas
**CIRCULATION MANAGER**
Michael Prior
**PUBLISHER**
Michael Hannan
**ADVERTISING MANAGER**
Selwyn Sayers (02) 353 0734 Fax: 353 0613
**HEAD OFFICE - EDITORIAL**
180 Bourke Road, Alexandria, NSW 2015
P.O. Box 199, Alexandria 2015
Fax number: (02) 353 0613
**Reader Services:** Phone (02) 353 0620
**Subscriptions enquiries:** phone (02) 353 9944
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**INTERSTATE ADVERTISING OFFICES**
**MELBOURNE:** 504 Princes Highway, Noble Park, Vic 3174. Phone (03) 795 3666. Fax: (03) 701 1534, Nikki Roche.
**BRISBANE:** 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119. Fax: (07) 252 3692, Ken Yates.
**ADELAIDE:** 98 Jervois Street, Torrensville, SA 5031. Phone: (08) 352 8666, Fax: (08) 352 6033, Sue Bowshall.
**PERTH:** Allen & Associates, 54 Havelock Street, West Perth, WA 6005. Phone: (09) 321 2998, Fax (09) 321 2940, Tony Allen.
**UNITED KINGDOM:** John Fairfax & Sons (Aust), 12 Norwich Street, London, EC4A 1BH. Phone: (71) 353 9321, Fax: (71) 583 0348
**ASIA:** Headway Media Services Ltd, Room 2101, Causeway Bay Centre, 15-23 Sugar Street, Hong Kong. Phone: 516 8002, Fax: (862) 890 4811, Adrian Batten.
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# LETTERS TO THE EDITOR

## Printer part: help needed

Having been a subscriber since April 1988, I thoroughly enjoy your magazine each month and find just the right balance of 'complexities' for this self-taught 21 year old to be able to understand. Tom Moffat is an amusing addition and I hope he continues.

I have built a number of your projects and have as yet not had a problem (pretty good, eh?). Anyway, while I'm here, I have a small request and it goes something like this.

A few years ago, I purchased a Mannesmann Tally MT81 9-pin printer for around $280. The problem is my print head is about worn out and one or two pins are nearly not working at all. Simple, you say — get a new print head.

Well, I rang Siemens and the very helpful young lady told me that, yes, the part was readily available — they even had some on the shelf ready to go. Hooray, I've finally found one! (This is after about six months of phone calls). "Tell me how much, and I'll send off the cheque tomorrow."

"No problem, sir. That's $290."

After I scraped myself off the floor, I thanked the young lady very much and bid her goodbye.

Now if anybody reading this just happens to have the part in question laying around, or a complete printer in a 'dead' condition for a few dollars, PLEASE let me know.

It makes me wonder, just how much the plastic bag and postpak is worth. (I know, that price must have included a lifetime subscription to *EA* — heh, heh, heh!)

Craig Bailey,
Palmwoods, Qld.

*Comments: Thanks for the compliments, Craig. We'll pass on any responses we get, from people who can help.*

## Caller ID

Your correspondent Eric Lindsay (October issue) may well be right in his criticism of the 'Caller Identification' proposal. But this should certainly be made available to emergency services, which, by means of a 'reverse' computerised directory, can readily establish the location of an emergency when, for one reason or another, the caller fails or is unable to give this information, Caller ID is already being used in this way in Australia.

What about protection from nuisance calls? I was myself subjected to a campaign of nuisance calls from a certain party whose identity and phone number I knew. I could get little help from Telecom, which merely suggested that I go to the police or take legal action; one can imagine the reaction of an over-stretched police force with more important matters on their hands!

But surely a practical alternative to caller ID should be possible in these days of computers and other technological marvels, by simply instructing the equipment to block all calls to the target number from the nuisance-originating number — no doubt in return for a fee (payable by the victim!)

Of course this would not prevent nuisance calls from a public phone, but in my own case I doubt if the party concerned would have bothered to go to all that trouble. Anyway, what I suggest would be of some help.

I was forced to have my number changed and go unlisted, with all its attendant inconvenience and cost. It might be of interest for your correspondent to note that an unlisted number does not protect against calls by market surveys and the like, which apparently generate lists of telephone numbers by computer!

It will be interesting to see where Caller Identification goes in the future; perhaps it will be limited to emergency services.

Michael Gamble,
South Yarra, Vic.

## Fibre-optic trials

I read 'Moffat's Madhouse' in the March issue of EA with great interest. His article and certain developments in the area where I live have encouraged me to put finger-to-keyboard.

Tom's article describes how 20 years ago he attended a press conference where it was demonstrated that video could be transmitted along a fibre optic cable. Of course, at the time this was quite impressive, but very simplistic since using light as the transmission medium means a bandwidth of 100's of GHz (thousands of TV channels), whereas they were sending only one video signal.

Currently, telecommunications com-

panies use more and more of the available bandwidth. As you know, many cities and towns in Australia are already interconnected with fibre-optic cables due to the amount of phone/data links that are required. Tom mentions that 'Australia's telecommunications utilities plan to run a strand of fibre optic cable into every house in the land...' one day. Would you believe that the future is sooner than you think?

Telecom is planning a trial of optical fibre connections in two areas on the NSW South Coast. The idea is to trial high capacity phone/data links and a video service in a business and residential area. The business area chosen is an area just south of the Wollongong CBD, and will involve 70 customers with businesses there.

The residential area selected needed to be relatively new, so that the underground conduit is in good condition to allow the fibre to be pulled through. Also, the area had to have poor TV reception. The suburb chosen is Cordeaux Heights, near Wollongong and how's this for luck — I live in the selected area!

The trial will start in July 1993 for a period of two years, and will involve 140 of the approximately 300 customers in this area. Basically the idea is to provide a high capacity phone/data link and a video service of up to 20 channels to the trial areas. This will involve no extra cost to the customers (normal Telecom charges still apply).

Oviously, people with businesses or those who work from home may use some of the advanced features of the system, e.g., ISDN.

Most customers will simply enjoy a clearer phone service (no problems with using the phone during electrical storms) and the video service which will comprise the ABC, SBS and local commercial channels (negotiations are still in progress with the commercial stations).

This also opens the way for a type of cable TV service, if there are any parties interested in setting it up for the trial period.

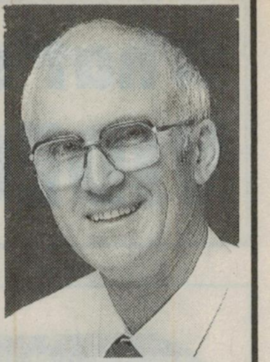
Not bad, I hear you say! I'll keep you posted.

Peter Ihnat,
Wollongong, NSW.

## DROP US A LINE!

Feel free to send us a letter to the Editor. If it's clearly expressed and on a topic of interest, chances are we'll publish it — but we reserve the right to edit those that are over long or potentially libellous.

# EDITORIAL VIEWPOINT



## *Helping Australia's technicians keep up with galloping technology...*

A few weeks ago, I was able to attend a weekend technical training seminar in Hobart organised by the Tasmanian Branch of TETIA — The Electronics Technicians Institute of Australia. The seminar was held in the Convention Centre of the Wrest Point Hotel Casino in Sandy Bay, and was presented by a team of lecturers from Mitsubishi Electric AWA, headed by that firm's NSW Service Manager Ruben Ferrero. It covered a wide range of products, from the latest colour TVs and VCRs through CD players and microwave ovens, to fax machines and cellular phones. The aim was to help practising service technicians keep up to date with the latest technology, and this seemed to be achieved very well.

One of the things that struck me about the seminar was how much planning and preparation had obviously been done by the Mitsubishi team, in order to ensure that their presentation was both effective and informative. They had planned the technical level carefully to suit the likely audience knowledge for each product, and had brought knocked-down examples of products to allow illustration of both the technology and appropriate servicing techniques. A video camera and large-screen CTV's were also used to provide 'close-ups' of small items etc, while an overhead projector was used to illustrate points made. During or at the end of every session, everyone was also given one or more sets of printed notes and further reference material. In short, the presentation of the seminar was very professional indeed.

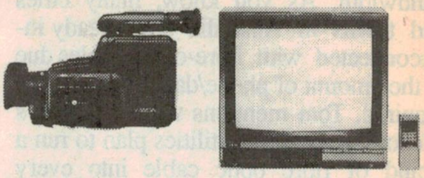
I gather that the Mitsubishi team has been providing this kind of seminar for about eight years now, and that their firm is one of the few which provide training for independent service technicians, in conjunction with TETIA and other industry organisations. (Most others generally only provide training for their own appointed service agents.) For this I believe they're to be congratulated — not only on behalf of the technicians they help to update and upgrade their skills, but also because of the long-term benefits which will inevitably flow on to the consumers, whose products those technicians will be able to service much more effectively.

I only wish that more consumer electronics manufacturers would follow Mitsubishi Electric's example, and provide this level of professional training. In the meantime, hopefully Mitsubishi itself will accrue some deserved advantage in the market place, as a result of its investment in technician training. I know my own evaluation of the firm's consumer products rose significantly during the seminar, as a result of learning more about both the products themselves and the way that they're supported. (Not that I didn't have a good deal of respect for them already — although Mitsubishi Electric sometimes seems a little backward when it comes to marketing.)

My thanks to TETIA's Tasmanian Branch for inviting me to their seminar. One of the nice things about making visits like this is the way you meet so many 'old friends' you didn't even know you had, among *EA*'s readers!

***Jim Rowe***

# What's New in VIDEO and AUDIO



## Yamaha A-V amplifier with 'Cinema DSP'

The new Yamaha DSP-A2070 audio-visual amplifier incorporates the company's 'Cinema DSP' technology, a development from its long experience with digital signal processing and in co-operation with movie sound designers. Yamaha claims that it in effect multiplies Dolby Pro Logic by digital sound field processing, creating more natural, spacious and full sound fields that are true to the intentions of the movie sound director, and an accurate re-creation of 70mm cinema sound.

In addition to providing six A-V sound field modes (Concert Video 1 and 2, TV theatre, Movie Theatre 1 and 2, and Dolby Pro Logic), the DSP-A2070 also provides six standard audio sound fields: Concert Hall 1, 2 and 3; Church, Rock Concert and Jazz Club. Each of these primary modes is further subdivided, giving a total of 23 different sound field modes.

The proprietary YSS-213 LSI chip at the heart of the DSP section also incorporates a 19-bit A/D converter with exceptional linearity and 114dB dynamic range, plus an interpolative 18-bit D/A system for each of the seven audio output channels.

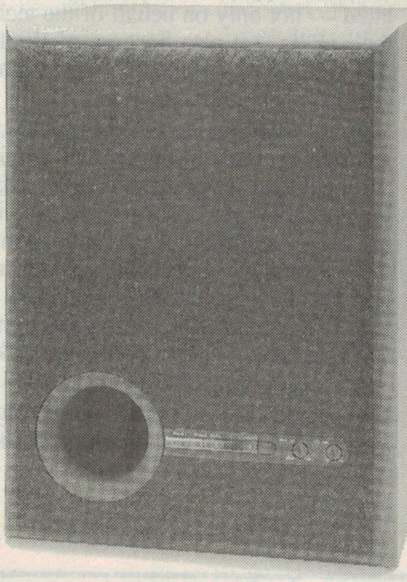
The main channels of the DSP-A2070 deliver 130W RMS into eight ohm loads, while the centre channel delivers 80W into an eight ohm load. The four 'effects' channels each deliver 25W into eight ohm loads.

Yamaha has also released a new active subwoofer, the YST-SW500. This uses the company's 'Active Servo Technology' to deliver clean, deep bass from a very compact 38-litre enclosure measuring only 330 x 440 x 380mm, and weighing a modest 22kg.

The rated frequency response is from 20Hz to 160Hz (-10dB), while the cutoff frequency of the inbuilt 24dB/octave high-cut filter can be adjusted between 40 and 140Hz.

The inbuilt amplifier produces 120W into the 5-ohm 25cm driver, which boasts a shielded double magnet structure and a Spruce cone. The woofer also features an IR remote control.

Both the DSP-A2070 and YST-SW500 are available from Yamaha dealers.



## Prices drop on PAL Laserdiscs

Up until now, there have been two factors tending to limit the growth of Australia's market for PAL Laserdiscs: the relatively small number of movie titles available in the PAL format, compared with NTSC, and their price. Many movies were priced at around $117, making them much dearer than either NTSC discs or PAL videotapes. However the price deterrent has just been reduced significantly, with a reduction announced by distributor Columbia TriStar Hoyts Home Video.

Explaining that the rapid development of European PAL markets has allowed larger production runs and lowered the landed cost of PAL discs in Australia, Columbia TriStar has lowered the cost of movies on a single two-sided PAL disc to $60, and that of a movie on two PAL discs (3/4 sides) to $70.

This still leaves the factor of limited title range, of course. To date only 80 titles have been released, but the company says that the same developments that have made possible the drop in prices will also lead to a broader range of available titles in the near future.

## New AM-FM tuner from Kenwood

Kenwood have drawn upon many years of tuner research and development in producing their latest Quartz Synthesised Tuner, the KT-6040.

Marketed at an affordable $499, the KT-6040 incorporates many outstanding features, including the ability to receive stations clearly from crowded FM bands (selectivity), combined with the sensitivity required by many rural listeners.

Switchable IF modes enable Narrow, Normal and Wide IF selection. This is particularly useful in crowded station areas with strong adjacent channel interference.

By switching to Wide Mode it offers the tuners full potential in terms of bandwidth and low distortion. Similarly, front end sensitivity can also be controlled with the RF selector, offering a 'Distance' setting for distant stations and a 'Direct' setting for local stations and to

## High reliability VCR from Panasonic

Following an enthusiastic response to Panasonic's Super Drive VCRs, the company has expanded the range to include a hifi model.

Like its Super Drive predecessors, the SD10 and SD20, the NV-HD100A hifi model offers the same fast response time. It includes many popular features, including jog/shuttle controls on the main unit and long play.

The NV-HD100A also boasts a new standard of reliability and durability as a result of its reinforced componentry. It has 30% less mechanical components yet weighs the same as its predecessors.

The NV-HD100A is notable for its excellent picture quality and outstanding audio reproduction. To minimise crosstalk between the video and audio signals in the VHS format the NV-HD100A's audio heads record the hifi signals onto a 'deep' magnetic layer, located below the video layer.

The NV-HD100A Super Drive hifi VCR has a recommended retail price of $1099.

avoid the overload distortion from a strong local station. Kenwood's 'active reception control' circuit automatically adjusts both the IF and RF parameters according to the condition of the signal.

The reason for the tuner's impressive specifications is attributed to Kenwood's exclusive front end stage that employs a six gang tuning device in conjunction with an RF amplifier using an advanced gallium-arsenide FET.

Kenwood also employ at least three proprietary digital circuits, including a DLRC 'direct linear reception circuit' for greater tuning accuracy, a DLLD 'direct linear loop FM detector' that increases dynamic range and a distortion correction circuit that will cancel any harmonic distortion caused by the IF stage filters.

The tuner offers 39 random FM/AM presets that can be programmed by station call sign or frequency. Station selection is made via the large jog dial control or remote controller. Additionally up to three stations can be pre-programmed into the memory for timer operation.

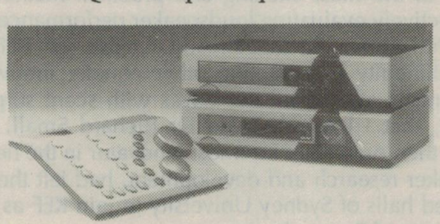
## Amber distributing Quad hifi products

Amber Technology has been appointed exclusive distributor of Quad audio products.

"Quad (Quality Unit Amplifier Domestic), was established in 1936 and has become world renowned for high performance and excellence in design," according to Mr John Fitzpatrick of Amber.

Quad's top of the range hifi products include pre-amplifiers, a compact disc player, power amplifiers, FM tuners and their famous Quad electrostatic loudspeakers.

The Quad 66 pre-amplifier and compact disc player are very compact and easy to use. The two units are operated from a separate control panel, which has large logically positioned controls and simple function labelling making it both user friendly and efficient.



The pre-amplifier controls volume, tilt, bass step, balance, filters, input selection and standby, and is operated from the infra red remote control panel. A total of seven inputs are provided, allowing connection of virtually any programme source.

Both power amplifiers use an identical circuit design, the only difference being power output. The Quad 306 provides superb performance with sufficient power to meet the requirements of most domestic systems, while the Quad 606 provides enough power for the most demanding systems.

Quad hifi products are available nationally through selected audio specialists throughout Australia.

For further information contact Amber Technology; phone (02) 975 1211.

## Marantz releases CD recorder

The Marantz CDR-1 Compact Disc Recorder makes it possible to record CD's which are for all practical purposes identical to pre-recorded discs.

While the CDR-1 will find applications in the professional recording industry, for recording jingles, masters and demos, Marantz says its retail price of $11,999 puts it within the range of the top end of the domestic market.

As well as its record function, the CDR-1 is able to perform as a conventional CD player, incorporating all the standard Marantz features such as Bitstream digital to analog conversion, track skip and search, random play, repeat modes and favourite track selection.

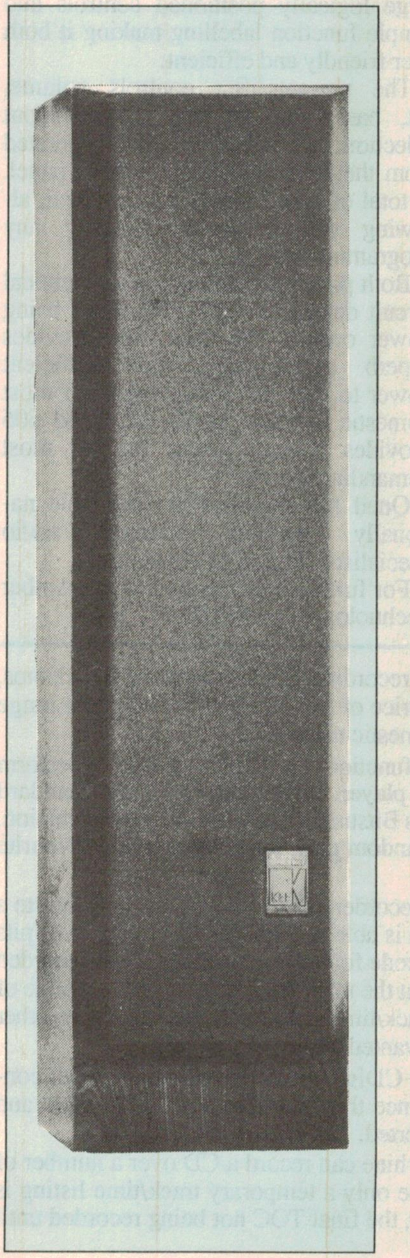
When operating as a recorder, the CDR-1's laser switches to a high energy level which is able to burn the spiral pattern of pits that contain the digital code found on a normal CD. A recorded CD cannot be erased, but the machine is able to create a table of contents (TOC - the track/time listing) which can direct other players to skip over unwanted sections of the disc.

CD's recorded on the CDR-1 are fully compatible with conventional CD players once they have been fully recorded and the permanent TOC inserted.

What's more, the machine can record a CD over a number of sessions. This is because only a temporary track/time listing is recorded with the audio, the final TOC not being recorded until the disc is complete. ❖

# KEF MODEL 105/3 UNI-Q LOUDSPEAKERS

This month Louis Challis had the opportunity to test and audition a 'domestic reference quality' loudspeaker system which has received glowing reviews in the UK, Europe, the USA and Japan — but only reached Australia quite recently. It incorporates a number of significant technical innovations, and his test results are very interesting indeed...



UK firm KEF Electronics has long had a reputation as being one of the most technically innovative and advanced manufacturers of quality consumer loudspeakers in the world.

I first met Laurie Fincham, their technical director, in Moscow at an International Electro-Technical Commission meeting in early 1974. He impressed me, quite apart from all the other delegates with his unusual breadth of knowledge, particularly in the area of advanced speaker measurements — an area in which he was head and shoulders above the rest of us.

The technology that Laurie developed, which I and others have long since copied, turned out to be one of the most exciting and practical methods of objectively evaluating loudspeaker performance.

With a team like that already in existence, KEF had no difficulty in attracting other equally innovative engineers and scientists. It was with scant surprise, then, that I later observed Dr Richard Small, who was then Australia's foremost innovator in the field of speaker research and development, had left the hallowed halls of Sydney University to join KEF as their Director of Research.

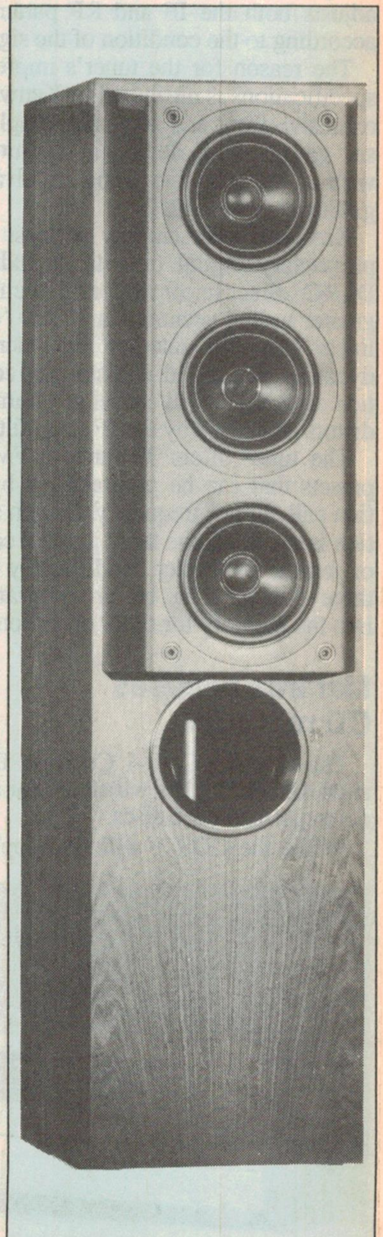
In the ensuing years, KEF has gone from strength to strength technologically. But alas they, like so many other manufacturers, are currently beset by the most difficult of times. In fact they have recently been bought out by a Hong Kong firm, which has injected appropriate dollops of cash to place the company and its affairs on a firmer basis.

## Looks deceptive

At first sight, (with the speaker grille in place), the new KEF Model 105/3 Reference Speaker system appears to be a relatively conventional, floor standing speaker system. It has dimensions and an overall appearance which would happily grace most living rooms (and even possibly some bedrooms), without necessarily disturbing either the decor or the 'supporting partner'.

On closer examination, I soon found that first looks can be somewhat deceiving. There are in fact a large number of unusual features about the 105/3 system that don't quite gel with the concept of a 'conventional speaker'.

The first thing that came to my attention on un-



packing the first of the speakers from its box, was that even when unpacked it weighted in at a hefty 42kg — which can easily lead to hernias and back problems, if one applies less than due caution and care when moving them around, for whatever reason.

On making an even closer inspection, I soon discovered that these are no ordinary speakers, for in lieu of the conventional face-mounted tweeter, with which all of us have become reconciled, KEF have headed off in a different way from the rest of the pack. They have followed Olson's concepts, and placed the tweeter at the throat of the mid-range driver.

Olson's initial paper in the *Journal of the Acoustical Society of America* back in 1939 set the acoustical fraternity on its ear, and although the second world war slowed him down more than a trifle, what he finally produced in the mid-1940's was ver good — still incomparably poorer in terms of its single point source characteristics, than the KEF 'Uni-Q' system, with which the 105/3's have been equipped.

The minuscule high frequency driver at the heart of the Uni-Q driver system has a diameter of only 25mm, and it takes advantage of a neodymium-magnet to achieve an inside-out magnetic structure. This is not only technically innovative and exciting, but more important, it actually works in the way that it was intended.

As you may well appreciate, the Uni-Q tweeter at the heart of the composite driver has been carefully positioned in the neck of its 160mm diameter midrange driver unit, so that the acoustic centres of the two units are truly coincident, both in respect of position, and more specifically in respect of their phase interaction. This composite unit then neatly and efficiently

***A special cut-away version of one of the KEF 105/3 enclosures, showing most of the drivers and their basic configuration. The tweeter unit is just visible in the throat of the central mid-range driver, while the metal tie-rod between the bass drivers can be seen inside the main enclosure.***

covers the frequency range 400Hz to just under 20kHz, with an overall linearity and smoothness in its response which really has to be admired.

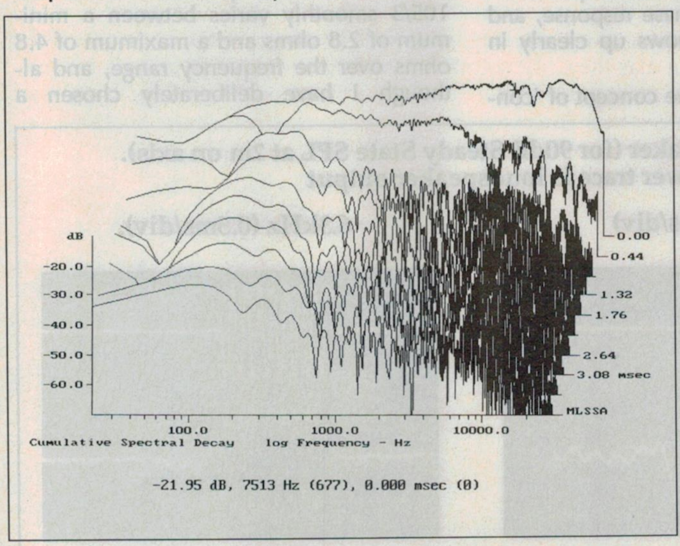
Immediately above and below the composite drivers are a pair of mid-low drivers, which have been designed to provide a gutsy coverage of the important frequency range extending from 160Hz to 400Hz. These two drivers have each been sealed within their own separate trapezoidal speaker enclosures, which are integrated into the front of the main speaker cabinet.

The woofer system is almost a subwoofer system, as it covers the frequency range 30Hz to 160Hz, to provide an exceptionally punchy low frequency performance — which my measurements and observations have confirmed to be 'almost at the top of the class'. The system uses a pair of 200mm bass drivers, whose magnet assemblies and primary fixed elements have been interconnected by a tie bar.

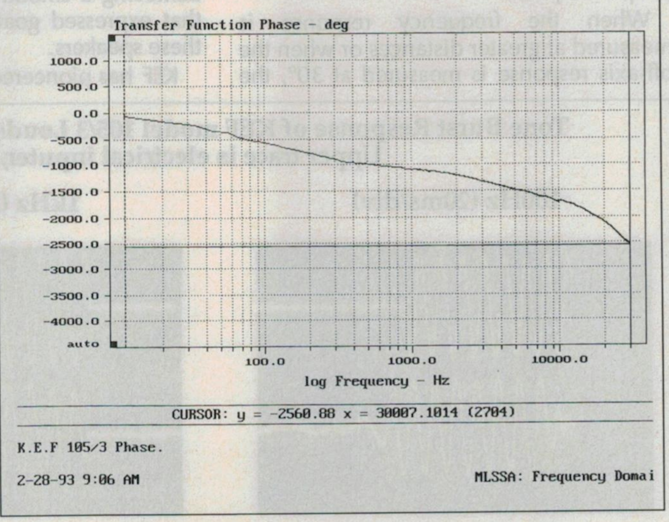
The tie bar is an essential element to counteract the reaction forces and movements of the magnet assembly, when high excitation levels are generated. Instead of that energy then being fed back into the cabinet to create an unwanted cabinet resonance, the equal and opposite reactions are absorbed in the tie rod with only a minuscule portion of that energy leaking past the system's primary line of defence to the cabinet — and thence to your ears.

KEF's PR people have made some mighty strong claims for this double coupled cavity format, with its two separate and rather special 200mm bass drivers. As I have already confirmed those claims are fully justified, as the woofer system in the KEF 105/3 really 'delivers the goods'. The acoustical output from the two speakers is fed out to the room by means of a single 125mm open flared port, near the base of the cabinet.

The speaker cabinet is extremely solidly constructed, from 22mm thick high den-




***The measured cumulative spectral decay characteristic for the KEF 105/3 system is fairly smooth, but does show some colouration in the mid-frequency area.***




***The system's phase characteristic is very smooth indeed, testifying to KEF's emphasis on this important aspect of loudspeaker performance.***

sity particle board which is veneered both internally and externally and well braced. The bracing as well as the form of construction has more than just a solid ring to it, and behaves most commendably when driven hard by the array of relatively complex drive units which it contains.

Although the 105/3 system was developed more than three years ago and has evoked very favourable comments from equipment reviewers in the United Kingdom and right throughout Europe and America, as well as in Japan, they appear to have been virtually ignored by Australian reviewers — who have in the main been denied the opportunity to review them.

As I see it, the two most technically exciting features of the KEF 105/3 are its innovative double bass drive units with their linked force-cancelling rod, and the Uni-Q system, which has been developed as part of a research project aimed at developing new and exciting technology suitable for multi-speaker DSP sound systems.

## Objective testing

The objective testing of the KEF 105/3 proved to be most rewarding, and it revealed that the frequency response of the system measured under anechoic conditions at 1m is reasonably smooth from 50Hz through to 18kHz, with one noticeable bump in the 200Hz to 400Hz region, and one notable notch in the vicinity of 10kHz, where the tweeter exhibits an anti-resonance.

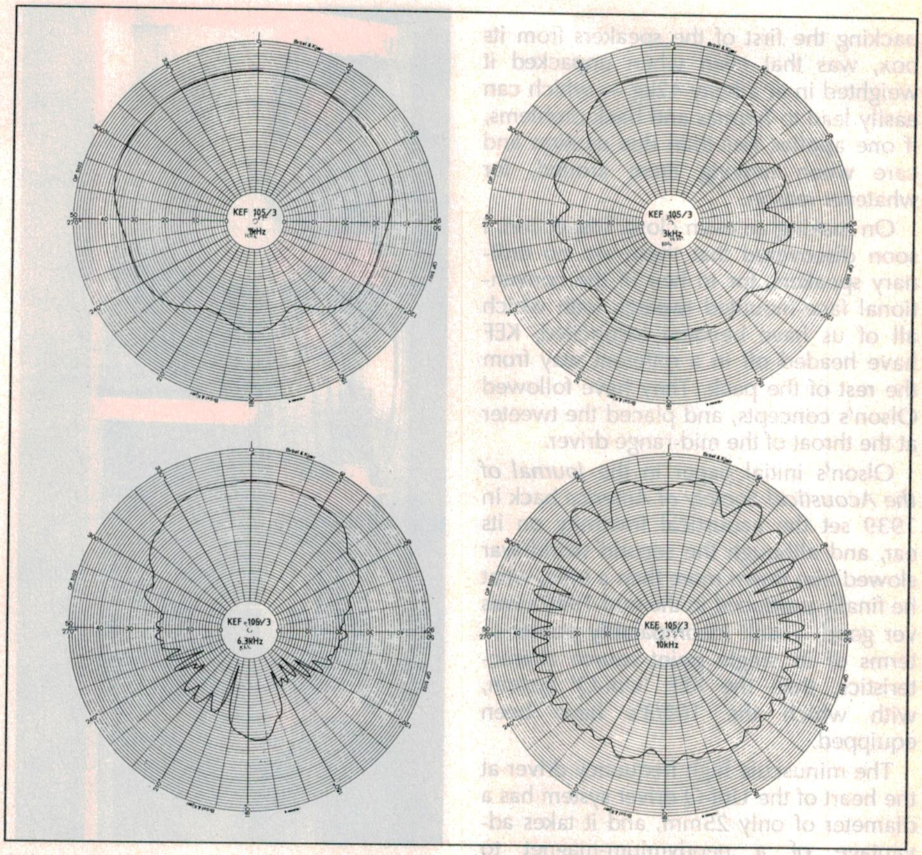
Apart from that, the bottom end is smooth and the mid-range is reasonably smooth — even if exhibiting a trifle more presence in the 2 - 6kHz region than some people may like.

When the frequency response is measured at greater distances or when the off-axis response is measured at 30°, the frequency response droops fairly smoothly in the 10 - 20kHz region, but is still reasonably good, and certainly on a par with the best of its competitors.

The phase response is also exceptionally smooth, and I was impressed by how smooth that phase response turned out to be. I have long been aware of the extent to which both Dr Richard Small and Laurie Fincham have placed emphasis on achieving a smooth phase response, and that expressed goal shows up clearly in these speakers.

KEF has pioneered the concept of 'conjugate load impedance matching', which ensures that the speaker presents the driving amplifier with a relatively flat and almost fully resistive load. This avoids the generation of 'funny impedance' responses, which some amplifiers dislike intensely, and which causes them to display their distress in a disturbingly audible manner.

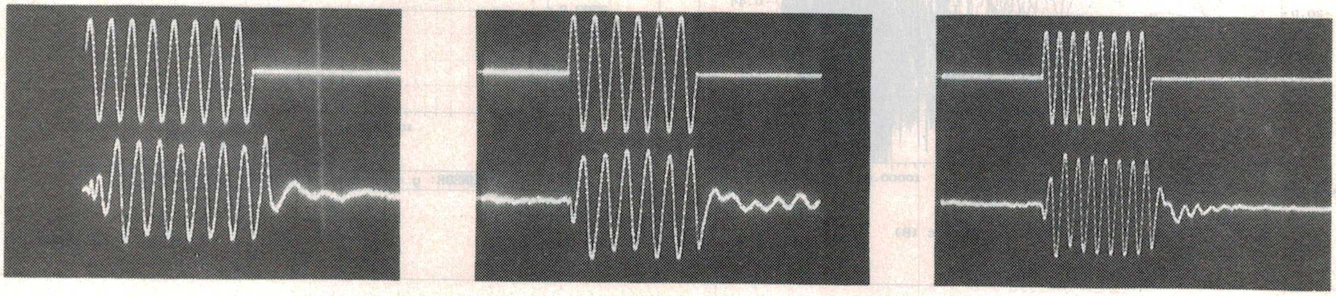
The measured impedance of the KEF 105/3 smoothly varies between a minimum of 2.8 ohms and a maximum of 4.8 ohms over the frequency range, and although I have deliberately chosen a




***The measured polar response plots for the system are very smooth as you can see, although some degree of directivity begins to appear at around 3kHz.***

**Tone Burst Response of KEF model 105/3 Loudspeaker (for 90dB Steady State SPL at 2m on axis). Upper trace is electrical inputer, lower trace is loudspeaker output**

**100Hz (20ms/div)** **1kHz (2ms/div)** **6.3kHz (0.5ms/div).**



***The tone burst response plots are also quite smooth, and although there are some signs of carry-over, this is still rather better than the performance of many other comparable expensive speakers.***

logarithmic scale on which to present the measured results, that was purely a matter of convenience.

The polar plots of the KEF 105/3 are very smooth, and although the speakers start to exhibit some degree of directivity at frequencies as low as 3kHz, this is appropriately maintained within acceptable limits all the way through to 10kHz, at which frequency one can immediately observe the start of the interaction between the Uni-Q tweeter driver and its encompassing mid-range driver. Although the results of this interaction are reasonably small at 10kHz, there is a perceptible and measurable increase of this enveloping interaction at higher frequencies. Although I do not regard this as a significant problem, it does result in a measurable droop in the 'on-axis' measured response, and explains why the manufacturer recommends removing the speaker grilles if one wishes to achieve optimum listening conditions.

The tone burst responses are reasonably clean, and although there are some signs of carry-over, the results appear to be somewhat cleaner than the characteristics displayed by other comparable expensive speakers. The decay response spectra are also fairly smooth, although there is significant mid-frequency and high-frequency low level resonance which is also discernible on program content.

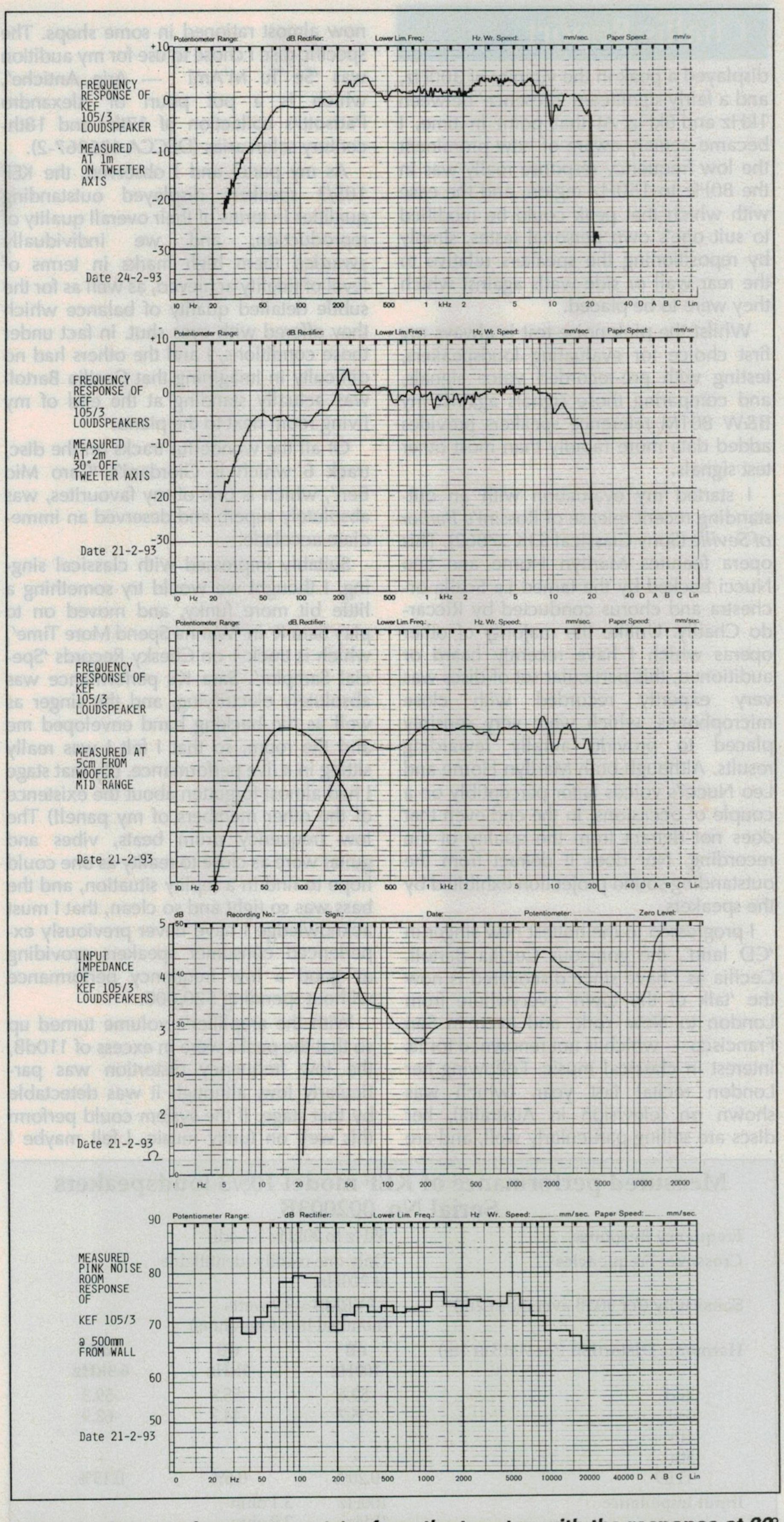
Taken overall, the objective testing of the KEF 105/3 displays physical and acoustical characteristics which are good. This is so especially at the low frequency end, where the pair of woofers can deliver a remarkable output, with a minuscule amount of distortion (0.2%), which virtually puts any other speaker system I have tested to shame.

## Listening tests

Whilst I acknowledge that the objective test results for the KEF 105/3's are fairly impressive, the 'acid test' for any loudspeaker is how well it performs when subjected to 'real' and/or 'difficult' program content.

As I have discovered over the years, the first and potentially most important 'one shot' test that can tell you how a speaker really sounds is to subject it to a pink noise test signal. That test signal will immediately display the presence of non-uniformity of linear frequency response — although it won't necessarily show up dips and notches unless supplemented by a room test of the type which is displayed in this review.

The pink noise test exhibited audible results that were far more coloured than I would have expected, and this was subsequently confirmed by the measurements I recorded with my one-third octave band real time analyser, which



***At top is the on-axis response at 1m from the tweeter, with the response at 30° off-axis below. Then follows the close-in response, the input impedance plot, and finally, the pink noise room response with the system 500mm from the wall.***

displayed a peak in the vicinity of 300Hz, and a fairly significant 'presence' between 1kHz and 6kHz. At that point in time, I became acutely aware of how prominent the low frequency response really was in the 80Hz to 150Hz region, and the ease with which that peak could be modified to suit one's own personal tastes, simply by repositioning the speakers relative to the rear wall or side walls against which they were to be placed.

Whilst the pink noise test is always my first choice for evaluating loudspeakers, testing with pre-recorded voice signals, and comparing those signals against my B&W 801M reference speakers provides added data more rapidly than most other test signals.

I started my evaluation with an outstanding recent release of Rossini's *Barber of Seville* (Sony Classical S3K 37862). This opera features Marilyn Horne and Leo Nucci backed by the famed La Scalla orchestra and chorus conducted by Riccardo Chailly. Unlike the majority of other operas which I have recently heard or auditioned, this particular set of discs was very expertly recorded with close microphones, which were very sensibly placed to provide aurally rewarding results. Although both Marilyn Horne and Leo Nucci's voices falter perceptibly on a couple of occasions, in the end even that does not detract from the quality of the recording. Nor does it detract from the outstanding sound projection exhibited by the speakers.

I progressed to the hottest new singer in 'CD land', the gorgeous Cecilia Bartoli. Cecilia as I have since discovered is now the 'talk of the town' everywhere from London to New York, and even in San Francisco — which is not renowned for its interest in classical music. Following her London recital last year, (which was shown on television in Australia), her discs are selling particularly well, and are now almost rationed in some shops. The specific disc I chose to use for my audition was 'Se Tu M'Ami — Arie Antiche', which is a pot pouri of Alexandro Parisotti's collection of 17th- and 18th-century salon arias (DECCA 436267-2).

As my panel and I observed, the KEF 105/3 speakers displayed outstanding qualities in terms of their overall quality of reproduction, and we individually awarded them high marks in terms of level of fidelity achieved, as well as for the subtle detailed quality of balance which they offered with eyes shut. In fact under those conditions, I and the others had no difficulty in imagining that Cecilia Bartoli was actually standing at the end of my living room next to the piano.

Of all the wonderful tracks on the disc, track 6 which is Giordani's 'Caro Mio Ben', which is one of my favourites, was absolutely superb and deserved an immediate accolade.

Suitably impressed with classical singing, I thought we would try something a little bit more funky, and moved on to play Sara K in 'Wanna Spend More Time', which is track 1 on Chesky Records 'Special Sampler'. Sara K's performance was absolutely electrifying, and the singer as well as the backing band enveloped me and the room, so that I felt I was really sitting in a live performance. (By that stage I had almost forgotten about the existence of the other members of my panel!) The low frequency drum beats, vibes and guitar were as close to reality as one could hope to find in a replay situation, and the bass was so tight and so clean, that I must acknowledge I have never previously experienced consumer speakers providing as good a low frequency performance without spending $20,000.

With the amplifier's volume turned up so that the peaks were in excess of 110dB, the low frequency distortion was particularly low, although it was detectable by that stage. If the system could perform this well on funky music, I felt maybe I should try something a bit more brutal. I moved onto the Sheffield Track Record (CD/14/20), which as it happens, constitutes a particularly mean — bordering on nasty — test for any conventional loudspeaker. Of course as I soon discovered, the KEF 105/3's aren't any ordinary loudspeaker, and what I heard was the tightest, smoothest, raunchiest bass that I have heard from any consumer loudspeaker system we've yet tested.

To say that I was impressed is putting it rather mildly, as every drum beat was extremely close to what I have come to expect from a live band, and was extremely tight.

I immediately formed the view that these speakers must have been designed with rock musicians and rock lovers in mind, as they reproduced low frequency sounds with a fidelity which I would only really have expected in speakers selling at more than twice their price.

The last set of discs that I chose for my comparison review was the Vienna/Berlin Ensemble playing Rossini's *Six Quartets for Flute, Clarinet, Horn and Bassoon* (Sony Classical SK52524). This is a brand new recording, and which incorporates superb renditions of some of Rossini's most delightful chamber style music. The producers have used an unusual, but most effective recording technique, which brings out the very best of the music. Once again the sense of realism achieved was positively dynamic, and by closing my eyes, I could accurately and precisely pick the position of every musician in the quartet.

**Measured performance of KEF model 105/3 loudspeakers**
**Serial No. 002003B**

| | | | |
|---|---|---|---|
| **Frequency Response** | 55Hz to 20kHz +/-4dB | | |
| **Crossover Frequencies** | Only one readily identifiable at 200Hz | | |
| **Sensitivity** (for 90dB average at 2m) | 6.3VRMS = 9.9 watts (nominal into four ohms) | | |
| **Harmonic Distortion** (for 90dB at 1m) | **dB 100Hz** | **dB 1kHz** | **dB 6.3kHz** |
| 2nd | -59.4 | -55.3 | -59.3 |
| 3rd | -55.7 | -44.7 | -62.9 |
| 4th | - | - | - |
| 5th | - | - | - |
| THD | 0.20% | 0.6% | 0.13% |
| **Input impedance** | 100Hz 3.1 ohm | | |
| | 1kHz 2.9 ohm | | |
| | 6.3kHz 3.5 ohm | | |
| | Minimum value at 180Hz 2.8 ohm | | |

## Summary

The KEF 105/3 system incorporates different concepts and vastly different features from most other conventional speaker systems with which they are competing and with which they may be compared.

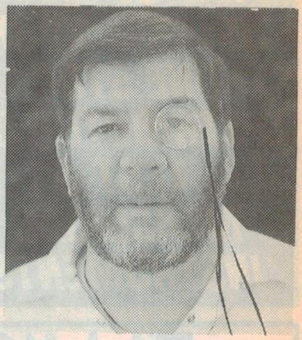
Whilst they are clearly a little pricey, and whilst I acknowledge that their RRP in the order of $6000 may well discourage most people who may wish to own them, that is not always a bar in itself. Expensive they are; however what they have to offer clearly justifies their price.

Based on my experience, they have the potential to offer a new dimension in listening pleasure, irrespective of whether your scene is rock music or happens to be closer to mine, which is invariably classical music.

Each speaker in the KEF 105/3 system is 1104mm high, 280mm wide and 405mm deep. As noted earlier they also weigh 42kg apiece. Further information is available from the newly appointed Australian distributor for KEF, Audio Works of 137 Victoria Road, Drummoyne 2047; phone (02) 819 6533, fax (02) 819 6312. ❖

# Moffat's Madhouse...

by TOM MOFFAT



## Colourful things that shouldn't have been

Buenos dias! — from New Mexico, USA. I'm sitting here in brilliant sunshine on a park bench, surrounded by several inches of snow, writing this on a disgustingly small palmtop computer.

I'm here on a three-week journey that will hopefully result in some interesting articles for *EA*, and some fun times for me as well — such as last night, when I went to a nostalgia restaurant that was a deliberate throw-back to the fifties.

They had things like a genuine (not reproduction) Wurlitzer juke box, but a major omission: no pinball machine. However it was still a pretty good effect, with the walls lined with murals of Elvis Presley and a '57 Chevrolet. And my dinner? A one-pound hamburger! But enough of that... I've got you in a fifties mood now, so let's get down to business.

Pay TV/Cable TV — it's the talk of our times. An almost infinite choice of new programs at the touch of a button. I got to see cable TV in action the third night I was here.

The first thing you notice is the TV listing in the local paper. There are 32 channel choices. Four of these are the local commercial stations, one is the fine American Public Broadcasting Network (a bit like our SBS), and the rest are stations that never see the light of the airways. They are all distributed by cable, for which the user pays US$22 a month.

Many are pay-TV, Australian style, where you must pay an additional fee for each film or program you watch. The rest are just like the free-to-air commercial networks. Most programming is films, with news and current affairs supplied by the likes of the excellent CNN (Cable News Network).

My first look at cable TV came after I was browsing through the paper and one listing caught my eye: Channel 11 — *Mothra* (giant moth wrecks Tokyo) followed by *Day of the Triffids* (1963 version), followed by *The Thing* (1951), followed by *The Green Slime*. That's it! I'm hooked! Cancel Saturday night!

Over seven hours of monster movies, two of them the powerful black-and-white heart stoppers from the fifties and sixties. Readers of this column may recall that I'm a hopeless sucker for this stuff, having already devoted a whole Madhouse column to *The Day The Earth Stood Still*.

I decided to give the *Mothra* thing a miss, to save my strength for the heavy stuff to come later. As *Triffids* got rolling I settled into a big plush American couch, surrounded by the TV remote control, some potato chips, a big bag of beef jerky, and some cans of Coors beer. I was going to freak out on USA culture.

Hey — *Day of the Triffids* was in colour! The way I remembered this old classic, it was in black-and-white. It certainly wasn't colour; but here it was, multi-hued.


I'd heard that some of these old films were being 'colourized' with some intensive electronic and video fiddling. I expected to see something like the old hand-painted photographs of the past, but here were people with people-coloured faces, and the sky was blue and the grass was green.

It all looked too good to be true, but there it was in living colour. As for the baddies, the Triffids (man-eating plants), I'd always assumed they were green when watching them as black-and-white, but now the Triffids had been doctored a bit with splashes of red and pink; perhaps to suggest bloood! Yaaah!

Colour seemed to make *Day of the Triffids* look a little more modern, but this wasn't such a good thing. It made the bad acting stand out.

When the film was made in 1962, horror films were supposed to look grotty with acting to match. And they scared the hell out of all of us at the Saturday afternoon cinema. (It's still there — the Hiland Theatre — after all these years. And it's still showing the good stuff — see the photo.)

Now to *The Thing*, and a bit of background. This film descended from a science fiction short story called *Who Goes There*, about monsters from outer space invading a polar research station and causing general havoc and destruction. The story was made into film in two very different versions, as well as being the inspiration for *Invasion of the Body Snatchers* and the more modern *Alien*.

The later version of *The Thing* followed the book almost exactly, and it's interesting to note that during this past summer, the Antarctic Division in Hobart was combing the city for a copy of *The Thing* to send down south with a wintering expedition. It would take some pretty intrepid explorers to to watch such a film, in total isolation,

in the setting where the story takes place. It gives me the willies just thinking about it!

The earlier version of *The Thing* took a lot of poetic license, twisting the original story and introducing a most worrying man/plant/monster. The film was produced by Howard Hawks in a manner carefully designed to ensure that nobody in the cinema went home with dry pants. The acting, as usual, was terrible. But the direction and lighting of *The Thing* was engineered to produce an impression of foreboding, of darkness, the feeling a kid gets at night wondering what's behind the cupboard door, what's under the bed. Oohhh yes! I remember it well.

Back to the telly. There I was, alone in the darkness. After a commercial break that seemed to run four and a half hours in itself, *The Thing* began, titles dripping onto the screen, eerie music. But the titles were RED! Oh, No! The colour freaks hadn't got at *The Thing* too! Oh yes they had, announced by an message that said something like, 'This movie has been colourized for your enhanced enjoyment'. Not to be a total knocker, I decided to sit back and watch, but with some trepidation.

The early parts of the film, the non-scary bits, seemed all right. In fact I'll have to admit that there might have been just a little bit of 'enhancement' from the colour. The polar scientists had discovered a flying saucer buried in the ice. The scene where they tried to melt it out with thermite bombs, and the whole thing blew up, looked pretty impressive. One of the saucer occupants was thrown out. He himself was frozen, and the scientists removed him still frozen in a block of ice to carry him back to the station.

Once back at the station the scary stuff started. The Thing was placed in a storeroom, under guard. But the guard couldn't stand the sight of The Thing's eyes looking up at him through the ice, so he threw a blanket over him — an electric blanket. Yikes!

The guard returned to reading his book as the electric blanket slowly melted The Thing from his icy prison — drip, drip, drip.

The scene got tense, and darker, and more foreboding. In the original black and white version, that is. In the colourized version the film technicians simply lifted the brightness as the scene got heavier — curing what they saw as a simple case of underexposure that had to be corrected. So what we saw in colour was an actor sitting in a nicely lit movie studio, putting on a frightened expression when The Thing finally sprang from the ice block.

In the original *The Thing* the action was deliberately moved from well-lighted interiors to dingy tunnels and passages around the polar station. The lighting in these started off awful and gradually got worse as The Thing became more threatening.

Sitting in the audience, especially as a kid back in the 1950's, this was just too much to take. As the tension built the cinema became almost totally silent except for some miserable whimpering from nearby seats. Remember the bit about wet pants? Well this is where it started.

Then The Thing burst through a heavy wooden door, into the dark tunnel! The scientists tried to slam the door on him, trapping his arm. And in that brief moment we saw, in the dingy black and white version, all our worst nightmares come true. (What's that warm wet feeling?) But in colour, we saw actor James Arness wearing a rubber suit. Nicely lit, of course. Bah! What a dud.

To cut a long story short, The Thing met his end in another dark passage, being zapped by electricity from all sides. In black and white this was pretty horrific, with almost all the light for filming coming from the electric sparks as they ground The Thing down to a pile of ash. But in colour it was just the guy in the rubber suit again, waving his arms and bellowing.

What I am saying here is that many black-and-white films use their very black-and-whiteness as their main special effect. Many people will say *The Thing* is rubbish, but I say is a fine example of using light and shade to build a mood, in this case a mood of absolute terror. Films of another generation — *Nosferatu*, *Phantom of the Opera*, *Hunchback of Notre Dame*, even *King Kong* all used this same trick. Any of these films, seen in colour, would look downright silly.

I remember a couple of years back some charlatan decided to colourize one of the Humphrey Bogart films, *Casablanca*. This was met with universal outrage. Reviewers to this very day still rave about the lovely black-and-white close-ups of Ingrid Bergman, which in *Casablanca* were raised to the level of fine portraiture.

Suggestions have even been made to colourize the old Fred Astaire-Ginger Rodgers dance films. These productions weren't known for their plot lines, which were generally pretty bubble-headed. Instead their excellence was in their fine snappy black-and-white imagery.

To colourize them would be to destroy them. In fact the later colour films of the Rodgers-Astaire team were pretty hopeless, compared with their earlier work.

I understand there is a push on, in the USA at least, to colourize *all* black-and-white films before showing them on television.

The technology is certainly there, and the results, at least from a technical standpoint, are marvellous. I gather the process is pretty well automatic, although it is somehow adding information that wasn't there in the first place. I would almost consider researching the colourizing process and doing an article on it. But I feel I really shouldn't, because it might tend to encourage the colourizers.

I say, colourize the junk films if you want to, but leave the classics alone. Especially the horror and science fiction classics. What colour did to *The Thing* was an outrage.

Luckily it was on ABC some time ago, in its original form, and I just happened to have my finger on the VCR record button at just the right time. So I now have in my possession a clean, virgin, black-and-white copy of *The Thing*. I just hope it isn't among the last. ❖

# THE CEDAR PROCESS: REMOVING AUDIO 'NASTIES'

Recently demonstrated in Australia, the English CEDAR digital signal processing system is putting an end to the traditional 'nasties' of audio recording — scratches, crackles, ticks, pops, hums, hisses and buzzes. You may well have already heard it in action, without realising it...

**by BARRIE SMITH**

Noise is our constant companion in the 20th century. An excess of noise can affect our health — from the likes of rock concerts and living under flight paths; an absence, as experienced during a short stay inside an anechoic chamber, can be grossly disturbing as every fragment of ambience is removed and we begin to hear the inner mechanisms of our own body rumbling and pulsing away.

Defeating noise in the real world is a continuing problem — an industry in its own right, a significant activity for corporations and protest groups. Our cities buzz incessantly, jets boom and (for anyone over 25 or so) rock music continues to hurt.

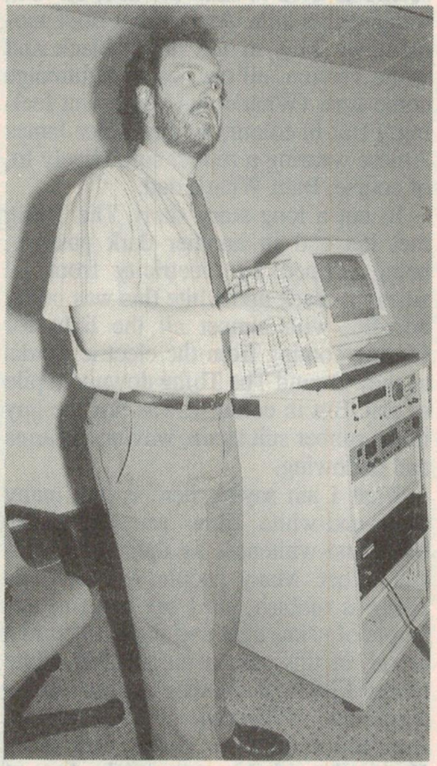
Possibly the only field of human activity where the detection and complete removal of unwanted noise is achievable is in the audio recording industry.

Many noise control methods have appeared over the years — from simple equalisers to computerised systems. Clicks, hums, buzzes — whatever the unwanted 'nasty' may be — can always be removed. But unfortunately a portion of the original wanted signal often goes too. The degree of signal loss varies with the sophistication of the removal system.

## Archival need

In the early 1980's, after abortive attempts elsewhere, the British Library's Sound Archive approached the University of Cambridge in a quest to make their archives more accessible to the public.

A way was needed to restore early recordings — held on everything from wax cylinders to optical sound on inflammable nitrate film. Eventually, a group of researchers developed an answer using digital signal processing, and from this a fledgling restoration system evolved between 1985 and 1989. In 1990 the system — CEDAR — surfaced as a commercial product.



*Gordon Reid, CEDAR's MD, running his live demonstration of the CEDAR system at ABC Sydney's Ultimo HQ.*

Gordon Reid, MD of the CEDAR company spent 10 hectic days in Sydney late in 1992, running demonstrations of the various system components to recording industry personnel plus others from TV and radio stations. I managed to attend two of Mr Reid's sessions.

## Based on PCs

The name 'CEDAR' is, as you might expect, an acronym standing for Computer Enhanced Digital Audio Restoration. Essentially it consists of a number of modules, using Artificial Intelligence, controlled by a PC (486 based) and operating in real time. Additional modules operate as a production editor for track compilation.

There are five fundamental modules in the restoration system. One of these is the real-time De-Scratch — 'scratch' includes all the relatively short duration impulsive disruptions: clicks, ticks, etc. These can be completely random in time, although such periodic things as cracks on records are included.

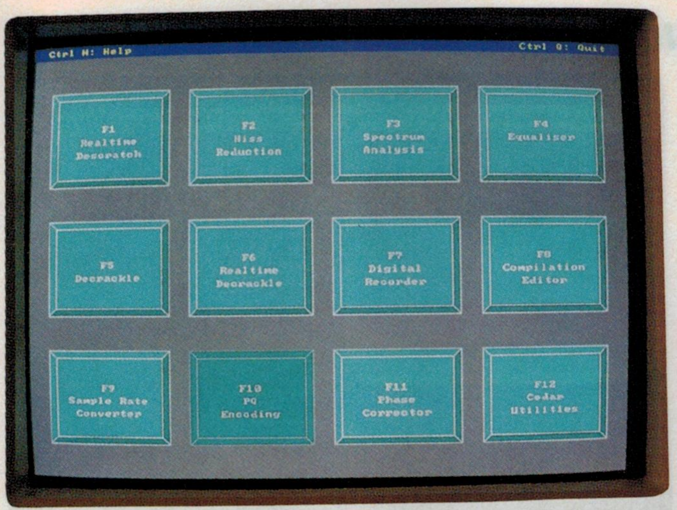
Another module is De-Crackle. This removes the very low level and ill-defined degradations which a standard scratch-type algorithm cannot detect or remove.

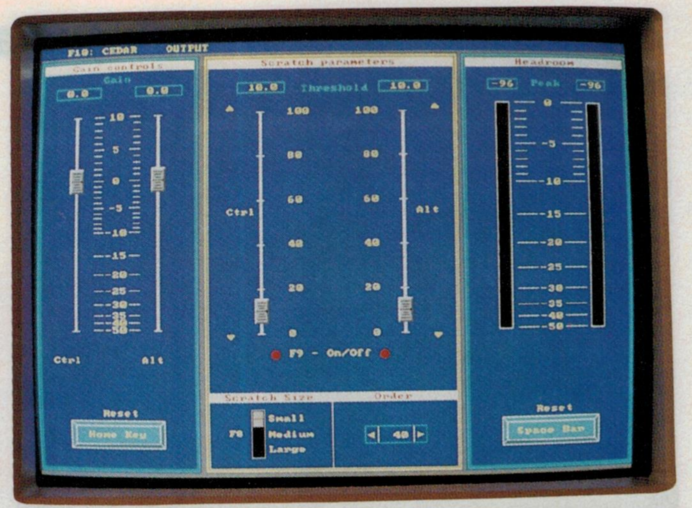
As Gordon Reid described, "It was discovered quite serendipitously that the De-Crackle module, with a little tweaking was able to remove certain classes of memory less amplitude distortion, such as the diaphragms of microphones grounding or the inputs of mixers becoming overheated".

Reid added that 'memoryless' can be considered as being opposed to 'with memory'. Tape overload is distortion 'with memory', i.e., there is a hysteresis curve on the magnetic tape and CEDAR can't cope with that.

Noise Reduction and EQ are the third and fourth modules. This includes broadband noise reduction — or hiss — but includes not only high frequencies, but broadband. The fifth module in the restoration side is Phase Correction, described as 'an incredibly accurate time correction system' for correcting time differences between left and right channels.

Additionally, modules can be assembled to make a production system. One of these is a fixed-rate Sample




Left: The overall CEDAR system menu as presented on the PC's screen — just a set of 'pushbuttons'. Right: The De-Scratcher menu. The operator needs no more information than this to successfully operate the CEDAR module.

Rate Converter operating at 32, 44.1, or 48kHz.

Reid explained: "All the facilities are contained in what we call the Compilation Editor and Automation Systems — which are editing, the ability to sequence tracks and to automate them according to SMPTE Time Code, with CEDAR either acting as the master or the slave.

We can also automate all the restoration functions within the editor automation system, and use that as a harness to control all other aspects of the system's operation."

## Quiet demonstration

A day of CEDAR demos was held at the ABC's shiny new Ultimo facility in Sydney.

Reid surprised the audience by not running a 'before and after' session of 'now you hear the clicks, bumps and hiss/now you don't', but conducting replays in real time of test samples from a Panasonic DAT machine through CEDAR, keyboard controlled by an Australian-made ASI PC host, through a format converter box then to a Micromega CD-R (Recordable CD) — used, as Reid offered, "as a very expensive D to A converter". Auditioning was via Australian-made Audiosound speakers.

In the real world a typical installation has CEDAR hooked up in a mastering studio to whatever hardware the studio uses — DATs, PCMs, etc. Any digital device can be attached to CEDAR — there are no analog inputs.

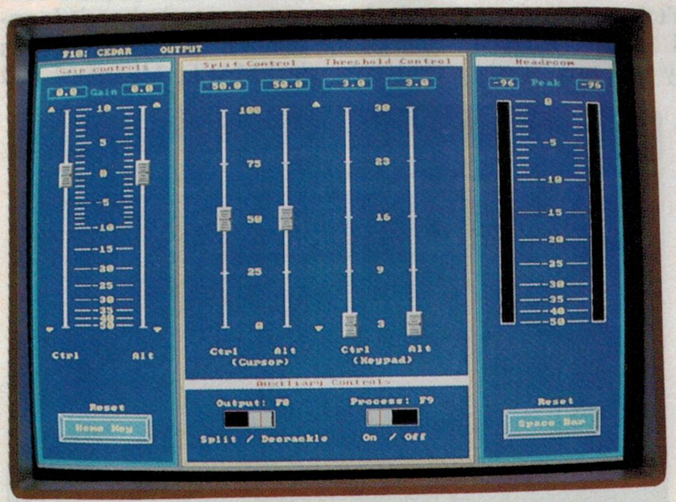
Reid explained "We specifically chose to do that (digital I/O) because many people have favourite converters. So there was no point in people paying extra money for converters they won't use".

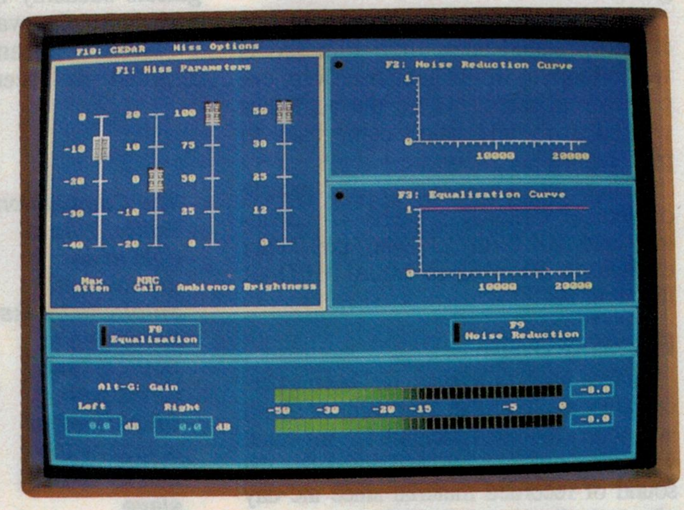
From 78's to LP's to recent CD's — the test ranged from Louis Armstrong to Phil Collins, to Kate Bush, to Elton John and a handful of classics. I've rarely heard an audience so silent at a demonstration of such state of the art equipment. It was not that everyone was impressed and stunned into silence — there was simply nothing to hear!

An original hissy track of a jazz piece, sprinkled with crackle. Yes, that's crackle all right. Re-route via the CEDAR De-Crackle module. Replay. So what? There's no crackle. And the music sounds perfectly clean.

So the demonstration continued, for an anti-climactic hour.

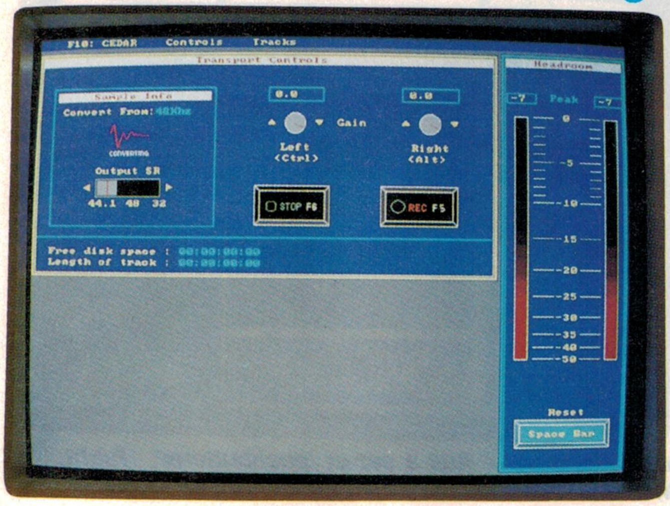
What made the event even less of an 'event' was CEDAR's use of screen displays for each of the modular functions — consisting of no more than one operational display for each module; no multiple menus, no pulldowns. Nor are there waveform displays or tangles of vari-

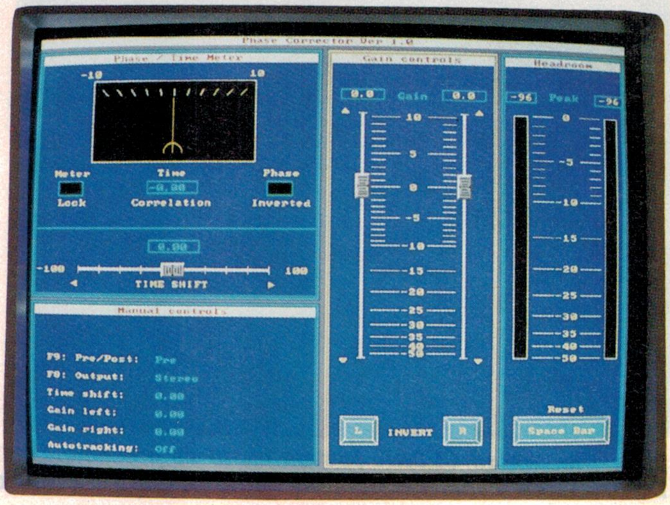



Left: The menu for operating the De-Crackle module. The interesting split function divides signal into noise-affected and clean signal for processing. Right: The De-Noise module menu. This module also includes EQ.

# The Cedar Process: removing audio 'nasties'





***Left: The user interface for the Sample Rate Converter, which is able to operate at 32, 44.1 or 48kHz. It provides headroom indication (on the right of the screen), and allows gain adjustment. Right: The Phase Correction module, which is accurate to .01 of a sample. Left and right channels can be shifted against each other via either auto tracking, or manually.***

ables to select from — 'user friendly' could well be an understatement.

## Existing users

The user base at present ranges from very large record companies — BMG, Sony, EMI — especially those using CEDAR for mastering CD's from all sorts of originals: cylinders, 78's, 33's, 45rpm vinyl, stampers, negatives, all types of mothers and shellacs, master tape, and digital transcriptions from any one of those. Other users are archives and radio stations, who use the real time De-Clicker in live broadcasts and for converting their jingles to CD-R. A number of TV stations re-master old films, by buying an otherwise untransmittable print very cheaply and then doing the restoration work themselves before going to air.

Reid added: "We've been asked to clean up sound takes from film shoots where looping would have been very expensive — cases where the actor has walked away and won't come back to post record".

"There are even one or two private owners of CEDAR systems — collectors and so forth — who are lucky enough to be able to afford CEDAR installations."

## Rapid growth

I asked Mr Reid if there had been a perceivable 'explosion' in the treatment of old and poorly recorded material. He answered wryly that people have tried improving the sound of recorded material since the day after recording was invented!

"The public's appreciation of recorded sound has appreciated dramatically since the launch of CD's. CD was first marketed in 1982/83 and announced as 'perfect sound', rather than exceedingly good reproduction of whatever you put on a CD. So, in the early days one went out and bought digitally remastered tracks — then quite legitimately screamed blue murder that it still sounded scratchy and hissy and horrid."

"But it has quickly become apparent that people's expectations have exceeded the quality delivered. Material that falls short of those requirements needs to be restored if it's going to satisfy the public. So a great deal of re-re-mastering is taking place", he added.

"CEDAR has been used to treat digital material as well. Some time around about the invention of digital equipment, all recording engineers and all film engineers suddenly became infallible and perfect. But that wasn't the case."

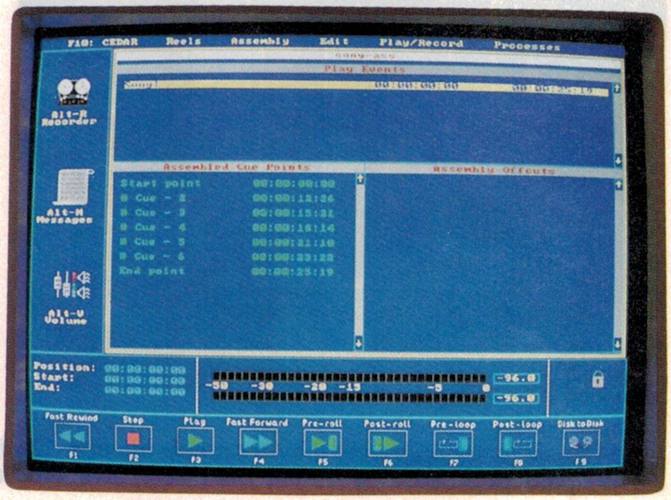
"We've cleaned up material recorded as recently as two weeks ago, which wasn't suitable for release because of errors introduced during the recording process."

## Easy to use

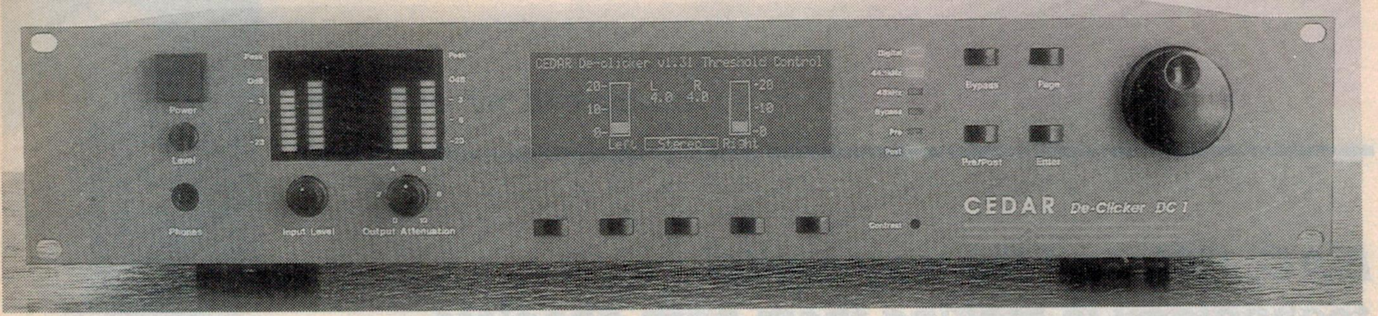
The foundation requirement of CEDAR is, according to Reid, that each module should be "simplicity to operate, so that audio engineers should not be forced to become computer experts and that all the information required be visible on screen at once".

Every single module includes a standard display of digital headroom indicators — as mock LEDs — and gain controls. That is consistent. Into that basic harness the required controls for the various processes are integrated.

**Scratch removal**: In the Scratch Removal window are the gain controls, headroom indicators and threshold controls for scratch removal. A switch optimises the removal of very fine clicks and ticks via SMALL, MEDIUM and



***The Compilation Editor. This is able to sequence and automate tracks according to SMPTE Time Code, with CEDAR either acting as the master or the slave.***




***CEDAR has also produced a rack mounting self-contained 'De-Clicker' unit, with DC-1, which uses twin internal 32-bit floating point processors running the same 'four pass' real time de-scratch processing algorithms used in the main PC-based CEDAR system. If features inbuilt A/D and D/A converters, is capable of removing 2500 scratches per second from each channel of a stereo signal, and is said to be 'ideal for CD re-mastering'.***

LARGE settings (LARGE refers to duration, not amplitude).

Waveform displays have been completely avoided, because according to Reid "many of the ticks and clicks you remove are not visible on waveform displays — and many of the things that look like them aren't! So the information can be very misleading".

CEDAR claims that the degradation is removed with no side effects whatsoever — the user need never know there was a problem in the first place.

One limitation is that very low frequency thumps (around 30-50Hz) can not be differentiated from music. Reid explained that "the degradation then is just sinusoidal in nature — and its removal would give you real problems".

CEDAR identifies all degradations by a set of modelling techniques, and the model differentiates between sounds which it considers genuine — real sounds which could be produced by the outside world, including electric guitars, synthesisers, drum kits etc — and artefacts which the system believes are not part of the required material.

Reid: "Obviously we educate the system. If the differentiation becomes impossible then the restoration becomes impossible."

The company holds open house to all their users, inspecting material which has resisted correction. This is analysed and, in many cases, the algorithms are improved.

**Crackle Removal:** Two sets of 'faders' appear on screen, because two processes operate — in real time. This is called the Split and Re-combine System.

Because crackles are too low in level and 'signal integral', they defy a single click detection process. It is not possible to detect crackle by eye. The signal, therefore, is split into signal components — with and without crackle. This has nothing to do with amplitude or frequency differentiation within the signal — being purely a mathematical function of the modelling.

Those elements of the signal that contain the crackle, now proportionately much higher, are identified and the crackle removed. Then the treated portion of the signal is recombined with the untouched segment.

**Noise Reduction and EQ**: Reid explains that "The theories behind various methods of spectral subtraction — identifying the spectral of the hiss and subtracting it from the signal — are very well understood.

The side effects of the process — strange effects like 'underwater' effects and burbling — and the loss of dynamic range, a loss of frequency range mean that, in my opinion, all other systems suffer from that."

"Even if you do remove the noise there's a great deal of psycho-acoustics involved. A signal only 12kHz wide may still have hiss going up to 22.05kHz. Excise this and the ear rebels and (if ears could talk!) says 'this is being dynamically compressed'. There is always the danger of a reduction in the integrity of the signal. That will always be most apparent in the high frequencies where the harmonics are, but less of the fundamentals."

"CEDAR boosts the frequencies required — which is usually the higher frequencies — without any amplification of the residual hiss. This is unique."

*Continued on page 67*

### CEDAR's R&D philosophy

The original CEDAR process was developed at the University of Cambridge, with most of its staff derived from the university. The company funds a number of research projects going on within the university.

CEDAR's MD Gordon Reid believes that typically "companies do not do research — unless they're the size of Philips or Sony. If you want to come out with something that is genuinely innovative and with a completely new approach, it will appear only from within a research environment".

"One of the reasons CEDAR is as good as it is that we've taken a very long term view of the whole science of signal restoration and processing."

### Further challenges

Obviously, there are other types of signal degradation, besides those currently handled by CEDAR: wow and flutter, limited bandwidth and unwanted compression.

Both within the company and the university, CEDAR are looking at those problems and those of non-linear distortions, such as tape saturation. As each of these problems are solved they will be integrated into the CEDAR system.

Already in existence is a prototype wow removal process (but not for flutter) which, Reid admits "the initial indications show will be very good".

### What about video nasties?

**Interviewer**: Are visual 'nasties' also in your sights?

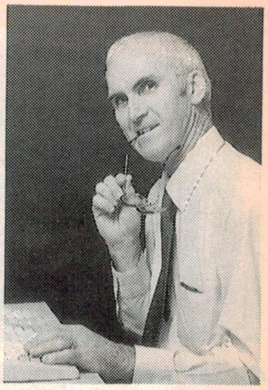
**Gordon Reid**: "OK — so we've got a psychic interviewer!"

A process for restoring damaged video images is apparently under development. Currently, it takes 'an excruciatingly long time to process', but Reid confesses "the results are as dramatic within the picture as CEDAR results are within the audio".

Two years may elapse before the product emerges but one thing is certain — its technology won't rely on compression.

# FORUM

Conducted by Jim Rowe



## *MAC, PAL and the way digital technology is making them both obsolete...*

**Let's give fancy audio cables and ELF fields a break for a while, and return again to the timely subject of video encoding and transmission systems. Our frequent correspondent and sometime critic Keith Walters has sent me a fairly long letter on this topic, and it raises quite a few interesting points. I feel sure you'll find it thought-provoking reading, as I did. Before we call Keith to the podium, though, I do have a short item to bring to your attention. This is that George Sprague of Philips has at last been able to provide a further official answer from his Company's engineers in Holland, on the subject of UV radiation from fluorescent lamps.**

You may recall that we published a short statement from them in the January column, with assurances that Philips fluoro's of all kinds easily met international standards for UV emissions. However there was no mention of a possible increase in UV emission over the life of the lamps, due to peeling, flaking or other deterioration of the phosphor coating inside the glass. Many of us have seen this happen, and wondered like our original correspondent Mr Rushworth whether it caused a dangerous increase in UV emissions. George Sprague said he'd try to get some further information on this aspect, but it took a little while to achieve this.

Finally it did arrive, though, and George very kindly faxed it to me. Here's what it says, after reminding us all that every fluorescent lamp operates by converting ultra-violet (UV) light into visible light, via the excitation of the internally-coated fluorescent powders:

*On the question of the possibility of the degradation of the phosphor coating, and its effect on the UV emission during the lifetime of the lamp:*

*1. The phosphor coating of all fluorescent lamps does not degrade during life. The powder (after wet coating) is sintered in a hot oven. The finished lamp is designed to withstand rough handling and transportation via air, road and rail over the entire distribution chain — factory, shipping warehouse, wholesaler, retailer and user.*

*2. The glass tube itself is of such composition that it filters UV almost completely. This is illustrated by the fact that our special application TUV-range (used in printing, germicidal etc.), which has no fluorescent coating, requires special glass. If normal TL glass were used these TUV lamps would be totally ineffective.*

*3. Philips TL fluorescent and compact fluorescent lamps comply with all international standards and the American Conference of Government Industrial Hygienists (ACGIH), regarding human safety related to unintended UV radiation. Not only does Philips adhere to the strictest norms on UV radiation, but Philips uses internally as a norm a PET (permissible exposure time) value of typically three times the limit set by the ACGIH.*

Well, there you are. The phosphor in fluorescent tubes *doesn't* flake — we all imagined it. And even if the phosphor *did* flake, the glass of the tube would filter out just about all of the UV anyway...

Seriously, though, I rang up George Sprague when the fax arrived, querying this blanket claim, and even *he* had to admit that he'd seen fluoro's with a peeling or flaking phosphor coating, in the past. Mind you, he was pretty sure they hadn't been Philips tubes, of course!

We came to the conclusion, he and I, that what the Dutch engineers are probably trying to say, albeit 'between the lines' and in their slightly stiff English, is that even though earlier tubes may have (or did have) a problem with flaking phosphor, this is no longer a problem as the result of improved design and manufacturing techniques like sintering and baking. Which sounds rather more reasonable, don't you think?

The point about any residual UV being filtered by the glass tube itself is a valid point, too. A few other readers have drawn attention to this as well, including George Neilson, VK3TES, of Blairgowrie in Victoria.

So one way and another, it does look as if the risk associated with UV emissions from fluorescent lamps is currently regarded as pretty slight, at least by the experts.

A final comment about this latest Philips statement, though. Do you understand that last bit about them using a PET of three times the ACGIH limit? It doesn't sound right to me; perhaps they meant a level one-third that set by the ACGIH. Either that, or they deliberately subject themselves to three times the limit, just to prove it's set too low...

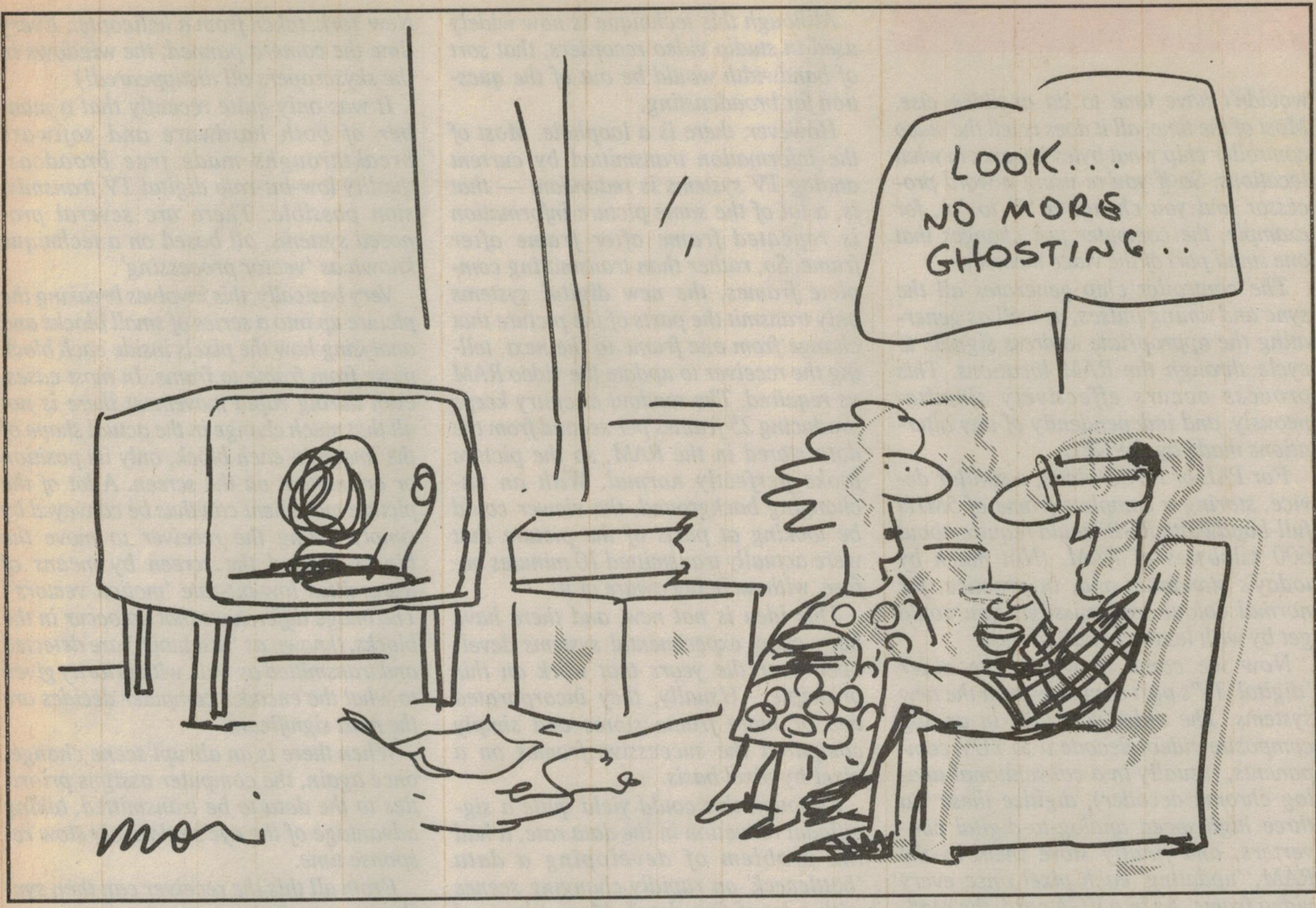
### Video encoding

Right then, let's leave fluorescent tubes again, and turn to the latest missive to arrive from Keith Walters. Keith is actually responding to the letter from Ron Demkiw, published in the January column, taking yours truly to task for my comments about HDTV in the November leader. (You might recall that Mr Demkiw pointed out that the MAC systems are in fact compatible with digital encoding, and could be used for a gradual 'digitalisation' of TV.)

Anyway, here's what Keith Walters has to say:

*I refer to Mr Demkiw's letter in January EA, concerning MAC systems, and how he still believes we should discard the old-fashioned (25 year old) PAL system, in favour of the 'modern' (12 year old) MAC system!*

*I know this whole subject is becoming pretty tedious, and your readers must be getting tired of it, but since your original*




*editorial was published there have been some dramatic changes to the state of play.*

*In my very first letter I made the assertion that "MAC systems are far from being a panacea for all the ills (real or imaginary) besetting modern TV systems". I wanted to point out that:*

*A: There's far more to improving our TV transmission and reception quality than simply tacking a MAC transmission system at the end of the chain.*

*B: There's still plenty of scope for substantial picture improvement within our existing transmission standards, and*

*C: There's little evidence of significant consumer demand for better image quality, and in my experience, quite a lot that suggests the reverse!*

*As far as I am concerned, none of your subsequent correspondents produced anything that effectively refutes these claims. When it's all said and done, I still don't think adopting a MAC system offers any real advantage to the average viewer.*

*A lot of your subsequent correspondents seemed to be more concerned with describing how MAC (and component video) could be shoehorned into our present TV systems — ignoring the issue of just why we needed to do so in the first place. It seems almost as though we have some sort of moral obligation to 'use up' the technology, as if it was ten pounds of tripe Mum bought on special somewhere!*

*You must be aware that the European parliament has now reversed its earlier dictum that all satellite transmissions had to be D2-MAC. I don't know the full details, but I would suspect a lot of non-technical politicians looked at PAL and D2-MAC monitors side-by-side and said something like: "Yeah — so what?" (Yes, I know there were many other factors involved too). A proposal to subsidize the initial operations of D2-MAC broadcasters has also recently been defeated.*

*It can be no coincidence that the great push for the adoption of MAC systems (and analog HDTV) came just when practical all-digital systems began to appear on the horizon. As one manufacturer of digital systems put it: 'Our new digital systems will blow any analog system clean out of the water'.*

*I would imagine most engineers expected that all-digital systems would come eventually; but like the collapse of the Soviet Union, nobody expected it to happen quite so soon or so precipitously. I am much more enthusiastic about digital transmission — unlike MAC, it offers real advantages to the viewer, with the potential to be considerably cheaper.*

*To avoid confusing your readers any further, perhaps we should define just what is meant by a 'digital' TV system.*

*To start with, forget about those Heath Robinson contraptions that have masqueraded under the title 'Digital Television Sets' for some years now. While they do use digital processing, none of the ones I've seen utilize it to anywhere near its full potential. (The manufacturers seem to have been more concerned with giving the owner access to a few gimmicky 'Digital effects').*

*The essential part of any digital TV receiver (true or 'imagined') is a 'digital frame store'. The video card of any modern PC with VGA or higher video standards is a simple example of one of these, consisting basically of some RAM chips, an LSI controller chip, three digital-to-analog converters, a crystal and few other low-cost bits and pieces.*

*Essentially, each location of display memory represents one pixel on the display screen. By continuously cycling through all the locations, the controller chip produces the RGB output signals via the DACs.*

*The computer's CPU isn't directly involved in this process — if it was, it*

*wouldn't have time to do anything else. Most of the time, all it does is tell the video controller chip what bytes it wants in what locations. So if you're using a word processor and you change a 'P' to 'p', for example, the computer just changes that one small part of the video memory.*

*The controller chip generates all the sync and timing pulses, as well as generating the appropriate address signals to cycle through the RAM locations. This process occurs effectively simultaneously, and independently of any alterations made by the CPU.*

*For PAL or NTSC video, a similar device, storing a complete frame of 5MHz full-bandwidth RGB would require about 600 kilobytes of RAM. (Not much by today's standards and, in practice, for normal colour transmissions you could get by with less than half of this).*

*Now we come to where the older 'digital' TV's part company from the new systems. The older sets take in analog composite video, decode it to YUV components, (usually in a conventional analog chroma decoder), digitize these via three high-speed analog-to-digital converters, and finally store them in the RAM, 'updating' each pixel once every video frame. As in a VGA card, the readout process is effectively independent from and transparent to the write process. By manipulating the read and write control circuitry, various functions such as line doubling, picture-in-a-picture, frame grab etc., are achieved.*

*All this is not an easy thing to do in a noisy and noise-sensitive environment like a colour TV set. Most sets only use 6-bit ADCs — 8-bit chips tend to be expensive and difficult to work with. (The sets I've seen the inside of have been a real dog's breakfast of wiring looms and heavy tinplate shields). The major problem, though, is that all the digital processing happens after the weakest link in the chain: the transmission system.*

*The new digital TV transmission systems work in a quite different manner, more akin to what happens on a computer's video card. The most significant difference is that the digitization process occurs prior to transmission.*

*For this to be practical, a lot of obstacles had to be overcome. Simply digitizing composite video directly would require a minimum data rate of around 100 megabits per second, which translates to a video bandwidth of around 70MHz. (Each 'cycle' carries 'one-and-a-bit' bits). For component video you'd need even more.*

*Although this technique is now widely used in studio video recorders, that sort of bandwidth would be out of the question for broadcasting.*

*However, there is a loophole. Most of the information transmitted by current analog TV systems is redundant — that is, a lot of the same picture information is repeated frame after frame after frame. So, rather than transmitting complete frames, the new digital systems only transmit the parts of the picture that change from one frame to the next, telling the receiver to update the video RAM as required. The readout circuitry keeps producing 25 frames per second from the data stored in the RAM, so the picture looks perfectly normal. With an unchanging background, the viewer could be looking at parts of the picture that were actually transmitted 10 minutes before, without being aware of it!*

*This idea is not new, and there have been many experimental systems developed over the years that work on this principle. Usually, they incorporated two or more frame stores and simply compared the successive frames on a pixel-by-pixel basis.*

*Although this could yield quite a significant reduction in the data rate, it had the problem of developing a data 'bottleneck' on rapidly changing scenes with a lot of fine detail. More advanced systems (such as NHK's 'Hi-Vision' HDTV system) were able to assign 'priorities' so that the least important data could be discarded in such a situation. (The best example of this problem I've ever seen was in an HDTV picture of New York, taken from a helicopter. Every time the camera panned, the windows in the skyscrapers all disappeared!)*

*It was only quite recently that a number of both hardware and software breakthroughs made true broadcast quality low-bit-rate digital TV transmission possible. There are several proposed systems, all based on a technique known as 'vector processing'.*

*Very basically, this involves breaking the picture up into a series of small blocks and analysing how the pixels inside each block move from frame to frame. In most cases, even during rapid movement there is not all that much change in the actual shape of the image in each block, only its position or orientation on the screen. A lot of the picture movement can thus be conveyed by simply telling the receiver to move the blocks around the screen by means of transmitted low-bit-rate 'motion vectors'. The image differences that do occur in the blocks, (known as 'residuals') are detected and transmitted as well, with priority given to what the encoder computer decides are the most significant.*

*When there is an abrupt scene change, once again, the computer assigns priorities to the data to be transmitted, taking advantage of the eye's relatively slow response time.*

*From all this the receiver can then synthesize new frames, re-using a substantial amount of the data already in the frame store. It sounds impossible, but it works! With current 'compression' techniques, full-bandwidth component video can be transmitted with as little as 6.6 megabits per second.*

### CHARACTERISTICS OF MPEG

A. It will be a consumer electronics standard. Sony, Phillips, JVC, etc. will drive high volumes for MPEG1 CD-I players and MPEG2 optical disk players.

B. The computer industry is interested in MPEG for multimedia applications.

C. Because there are multiple silicon vendors, e.g., C-CUBE, TI, LSI Logic, Thomson and AT & T, there will be competition. This, together with volume production, will drive down price.

D. MPEG-1 provides VCR quality at 1.1-1.5 Mbps for movies, while MPEG-2 provides good to excellent quality in the 4-8 Mbps range for full-motion video.

E. Decoder chips for MPEG-1 and MPEG-2-like algorithms exist today.

F. MPEG is a flexible syntax, allowing companies to compete on image quality by developing clever encoding strategies.

G. VLSI encoder solutions will exist for MPEG1 and MPEG2. This is important for applications requiring low-cost encoding, e.g., local insertion.

***Some of the basic features of the MPEG compressed digital video standard, as summarised by Scientific-Atlanta. (Reproduced by permission)***

| COMPARISON OF MPEG1 TO MPEG2 | |
|---|---|
| **MPEG1** | **MPEG2** |
| Designed for progressive scan (e.g. movies). Does interlaced scan by "pretending" it's progressive. | Handles progressive scan and interlaced scan. |
| Optimized for rates of 1-3 Mbps | Optimized for rates of 4-10 Mbps |
| Capable of frame processing only; hence optimized for progressive scan | Capable of adaptive field/frame processing; hence optimized for progressive and interlaced scan. |
| Capable of 4:2:0 mode only | Capable of 4:2:2 and 4:2:0 chrominance modes |
| Note: The ATRC HDTV proposal is MPEG1 only. | |

***A comparison of the MPEG-1 and MPEG-2 compressed digital video standards, again reproduced by courtesy of Scientific-Atlanta. The acronym ATRC stands for Advanced Television Research Consortium, composed of US and international companies RCA, NBC, Compression Labs, Philips and Thomson Consumer Electronics.***

*I saw some demonstration tapes of a 6.6 megabit/second system at the recent SMPTE show in Sydney and the picture quality can only be described as awesome. To forestall any questions about the system's ability to handle fast-moving images, the manufacturers made sure there were plenty of sports scenes such as ice skating and basketball games. As far as I could see, it was perfect. There was no sign of 'motion artifacts' whatever.*

*The figure of 6.6 megabits/sec was deliberately chosen, as this rate can be fitted inside a standard US TV channel bandwidth. That means the system can be used with 'terrestrial' transmitters as well as satellites, unlike MAC. (They also showed a 3.3 megabit system, described as 'VHS quality', although I thought it was quite a lot better than VHS).*

*Because a digital receiver only has to be able to clearly distinguish 'ones' from 'zeros', it can work perfectly with a receiver signal-to-noise ratio that would be hopeless for an analog signal. It only takes a small amount of ghosting or snow to produce visible picture impairment on an analog system — this would be completely ignored by a digital receiver. Iceland has recently installed such a system, giving it a 'live' satellite TV studio link for the first time. (Because Iceland is so far North, geostationary satellites appear very low on the Southern horizon — none of the previous analog satellite signals could successfully penetrate the thousands of miles of atmosphere).*

*Contrary to what Mr Demkiw implies, in practical terms, a digital TV receiver would be actually simpler and (at least theoretically), cheaper than a MAC receiver. There's no video processing to speak of, as the received digital signal would simply disappear into a number of large ASIC chips and come out as RGB (and audio) ready to go to the output stages. There would be few problems with digital hash leaking into the receiver's front-end, and less need for critical tuning or IF alignment.*

*Much of the technology is similar to that used in personal computers, and current generation digital decoders are said to have roughly the same computing power as a '486 PC. However, there are no disk drives, keyboard etc, so the price is quite a lot less. (Currently around $US700 for a complete system, including a 50cm satellite dish). There is no reason why the price shouldn't come down further with mass production, either.*

*The digital encoders are admittedly complex and expensive, but these are only needed at the transmitting end, and only one is required. (The encoder has to be very 'smart', to decide what data needs to be transmitted to produce the best possible picture within the bandwidth available — the decoders are by comparison 'dumb' devices). Further refinements to the encoder software promise to reduce the required bandwidth still further, while still retaining compatibility with existing receivers.*

*This is one of the great advantages of the digital systems — they can be made 'future proof'. Any enhancements to the received picture (such as wide-screen or higher resolution) can be made via the transmitted software, so that an existing receiver can still use the part of the signal relevant to it.*

*Also, one thing that is not generally realized is that this sort of transmission system can mean the end of TV standards as we know them. Transmitted pixels are defined on a co-ordinate basis, rather than as a scanned raster. The actual output video can have any desired line or frame rate, just as you can have what is apparently the same display on quite different types of computer monitors. Indeed, I wouldn't be surprised to see digital TV receivers in the form of cards that fit in a PC's expansion slot!*

*If the encoding technology can be made cheap enough for home use, it may well herald a new generation of video recorder, (probably using 'recordable CD' discs) which can produce true broadcast quality sound and pictures, and which (like audio CDs) will work anywhere in the world. (A VCR for digital off-air transmissions only could be easily achieved using current S-VHS or Hi-8 technology).*

*The only slight fly in all this ointment is that, as with the MAC systems, you only achieve the theoretical maximum picture quality when the studios are wired for component operation. Whether this will happen or not remains to be seen, but in any event, the situation would be no worse than with a MAC system.*

*In closing, You may be interested in the cover story on the enclosed publication.*

Phew! Thanks for those comments, Keith. I for one found them very interesting, and I find myself in pretty close agreement with much of what you say. (Is one of us mellowing with age?)

By the way, the item Keith refers to at the end of his letter is a story on the front page of the November 1992 issue of *TV Technology*, an international monthly published for the TV broadcasting industry by Industrial Marketing Advisory Services Inc., Falls Church, Virginia. Headed 'Japan Considers UDTV', the story explains that Japan is no longer content with its analog MUSE HDTV system, and is planning to develop a 'super fidelity, super resolution' digital video transmission technology, capable of providing an image quality comparable with 70mm motion picture film. (UDTV apparently stands for 'ultra-definition TV', and is meant to imply one step further than HDTV!)

The story also quotes Mr Kazuhiko Nishi, president of the ASCII Corporation of Tokyo, as saying that Japan "has face-saving problems after spending millions" on the MUSE system, but that most industry leaders now recognise the future of television is digital.

Having just had the good fortune myself to attend a most impressive demonstration of the MPEG1 digital video encod-

ing/compression and decoding/decompression system, given in Sydney by Scientific-Atlanta, I guess I too am now much more aware of the way digital video technology is developing. Techniques that were little more than engineers' pipe dreams only a couple of years ago have now become a practical reality in terms of first-generation equipment, and now it seems likely that within the next 12 months or so at most they'll be implemented in off-the-shelf chips. Phew!

By the way, MPEG stands for 'Motion Picture Experts Group', an international body which recently addressed the problem of arriving at a standard format for digital encoding/decoding of moving video images for consumer applications. The resulting MPEG1 and MPEG2 standards look like they may become an international standard for not only digital TV, but also computer imaging, digital video on tape, compact disc and other media, and digital video transmission via optical cable. (See data boxes)

This means that encoding and decoding chips made for these standards will have many potential applications, and are likely to be made in very large volumes — so their price should fall quite rapidly. I gather quite a few of the world's big chip makers are already well advanced with development of MPEG1 chips in particular.

Scientific-Atlanta's demo involved sending high quality studio-bandwidth PAL signals through one of their MPEG1 digital encoder/compressors, and then piping the resulting 8Mbps signals to Optus's facility at Frenchs Forest, where they were beamed up to a transponder on the low-power A3 satellite. A small 75cm offset-focus dish on the top floor of a North Sydney hotel was then used to receive the returning ku-band signals (South-East beam), which were then fed to a satellite receiver and a matching 'commercial grade' MPEG1 decoder/decompressor, driving some high-quality PAL monitors.

I can vouch that the resulting pictures were of very high quality indeed, with excellent signal-to-noise ratio, good resolution and no visible motion or other artifacts on the standard programme material. Only when a special test tape with images designed to show up limitations in digital encoding/decoding systems was run, were any artifacts visible — and then you generally had to look closely.

What made the demo particularly impressive to me was the fact that a low-power A3 transponder was being used, with reception via a dish only 75cm in diameter. Despite this the video signal-to-noise and subjective overall quality was much better than anything I've seen from standard analog FM/PAL transmissions from the higher-power B1 transponders, using dishes over twice this diameter — and an LNB of the same noise factor (1.0dB). The analog signals hadn't being crunched through digital processors at each end, either...

Steve Dean, Scientific-Atlanta's MD, told us that his company expects to be able to supply this kind of MPEG1/2 digital video decoder in low-cost LSI chipset form before the end of the year, and predicted that set-top decoders could be on the market by the middle of 1994. He estimated that a complete domestic ku-band satellite receiving setup for MPEG digital Pay-TV would cost less than $1000, including dish, LNB, receiver, inbuilt decoder-decompressor-descrambler and remote control.

So there's no doubt that digital video is coming, and much faster than most of us would have predicted. Technically there's no reason why it has to be restricted to satellite delivery, either — but that's another argument, and we've run out of space. See you next month? ❖

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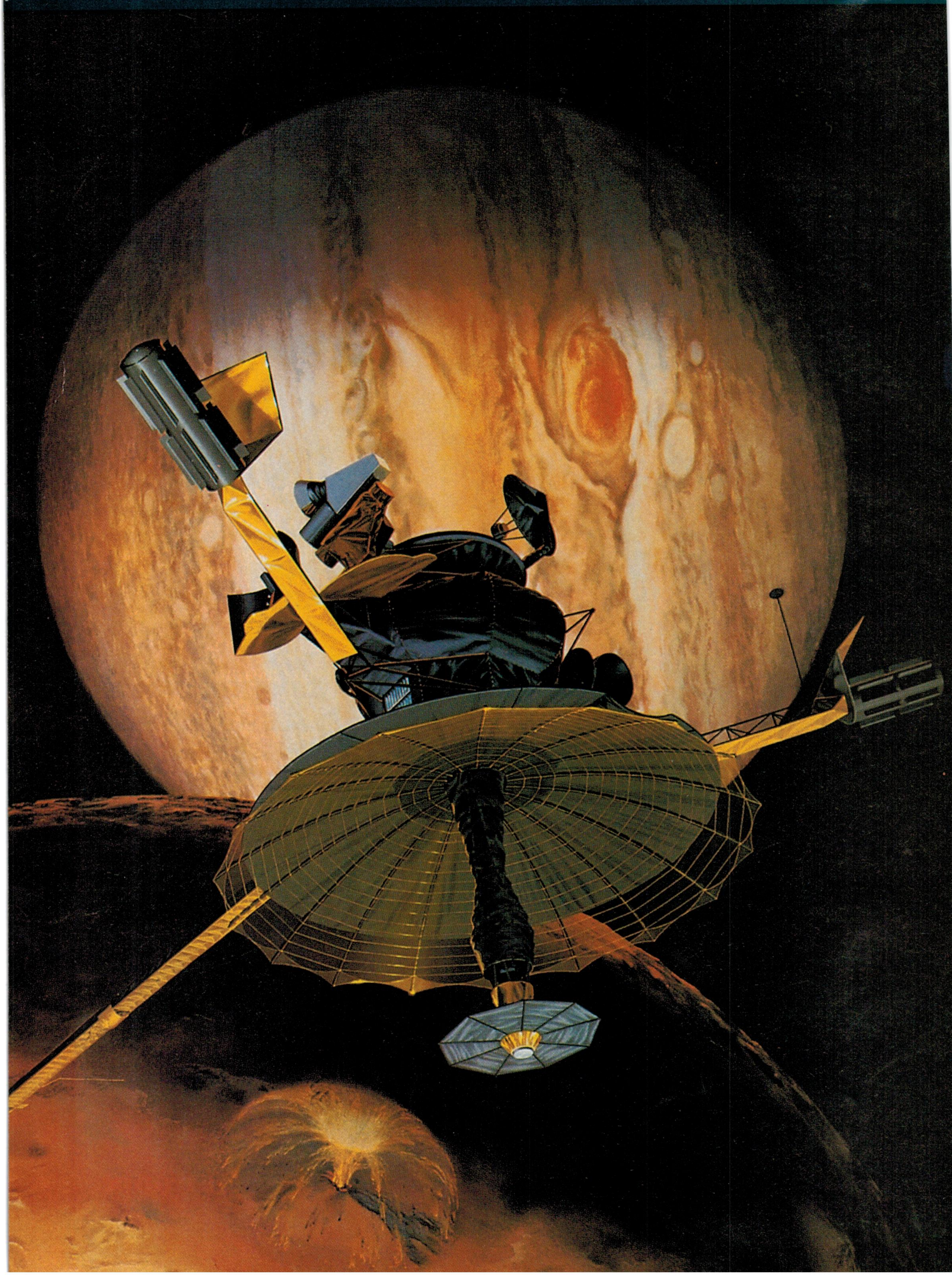


# GALILEO'S LONG AND ROCKY ROAD TO JUPITER

**After many trials and tribulations, including funding cuts, exploding spacecraft and legal challenges by environmentalists, NASA's Galileo space probe finally left the Earth on its way to Jupiter. Then came a further problem, which is yet to be solved: the failure of the high gain antenna to deploy properly. Despite this, NASA is still hopeful that the mission will prove at least 70% successful.**

**by KATE DOOLAN**

In January 1610, Italian astronomer Galileo Galilei turned his newly invented telescope skywards to the planet Jupiter. Whilst making observations, he noticed four small bodies floating across in front of the planet. These four objects were the Jovian moons Io, Ganymede, Callisto and Europa. These moons are now called the Galilean system, in honour of their discoverer.

Galileo continued to make many more observations with his telescope, including the discovery of sun spots and sighting, but not recognising, the planet Uranus. This was until he was tried by the Church for heresy in advocating the teachings of fellow astronomer Copernicus. Galileo was sentenced to house arrest and died blind and alone in 1642.

Three hundred and eighty two years after his epic discoveries, there is another Galileo which is set to discover Jupiter all over again. This Galileo is a sophisticated robot spacecraft which is currently halfway in its journey to the giant planet.

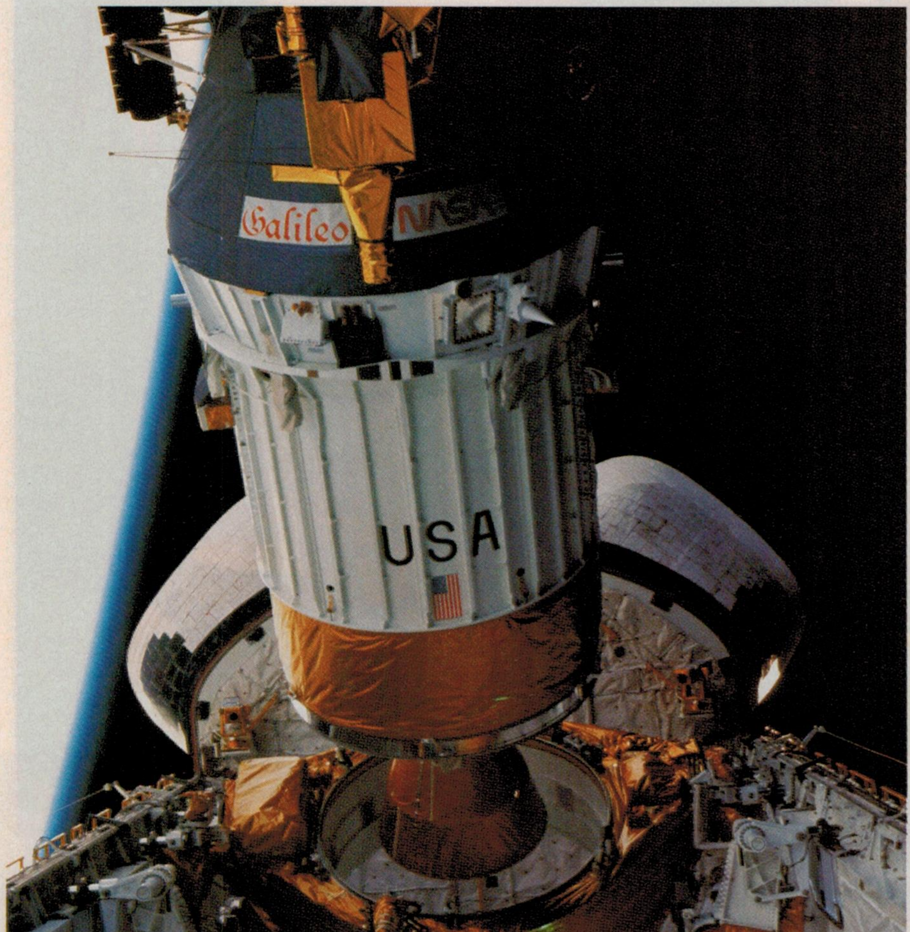
As with many planetary programs of the US National Aeronautics and Space Administration (NASA), Galileo has had a somewhat traumatic expedition to the launch pad. But unlike the other planetary spacecraft, Galileo's problems have not stopped with its launch. The high gain antenna of the spacecraft has failed to open properly, and there are now doubts whether Galileo will be able to perform to its complete potential on reaching Jupiter.

In 1975, NASA ranked the Jupiter Orbiting Probe (JOP) as its main priority for planetary missions in the eighties. NASA suggested that the JOP should receive funding so the project could start in financial year 1977. However, later that year, a Congressional committee removed the funding from the project with the excuse that the money was needed for the Large Space Telescope — which eventually became known as the Hubble Space Telescope.

What happened next was a turning point for space scientists and their political lobbying activities. Dismayed that jobs would be lost at the Jet Propulsion Laboratory (JPL) in Pasadena, California, the scientists went on the attack.

A frantic lobbying effort comprising letter writing, telephone calls and personal visits to Congress began. Some sections of the media (namely *Omni* magazine and the influential newspaper the *Washington Post*) began to run stories on the benefits of having the Jupiter Orbiting Probe.

Timely assistance came from an unusual source. In Philadelphia, five thousand 'Star Trek' devotees had arrived




***'Galileo' moves away from the Space Shuttle 'Atlantis' on the start of its six year journey to Jupiter. Deployment was achieved in six hours by the STS-34 five-member crew of the shuttle.***

for their annual convention. In a speech 'Star Trek' creator Gene Roddenberry told the Trekkers to show their commitment to space by lobbying their politicians to support the JOP.

In July 1977, by a vote of 280 to 131 in favour, Congress approved funding for the JOP — which was renamed Galileo in early 1978. The launch was then scheduled for January 1982, aboard the yet unflown space shuttle system.

The Galileo spacecraft is a joint project between the United States and Germany. The orbiter was designed and built by the Jet Propulsion Laboratory, while the probe was designed by NASA's Ames Research Centre and built by the Hughes Aircraft Company. The German government is a partner in the mission by the supply of the spacecraft's propulsion system, ground operations support and scientific instruments on both the probe and orbiter.

## Further delays

As the space shuttle continued to fall behind in its launch schedule, NASA delayed the 1982 launch until 1985. The Interim Upper Stage (IUS) that would be used to boost Galileo out of Earth orbit was also falling behind, so Congress ordered NASA to develop and use the liquid fuelled Centaur upper stage — which again delayed the launch until May 1986.

On 24 January 1986, Galileo arrived at the Kennedy Space Centre in Florida to begin final launch preparations. Four days later, the shuttle *Challenger* blew up, 73 seconds into its flight.

At first, NASA officials claimed that Galileo would meet its launch window of May, but the extent of the explosion and its causes gave NASA no other choice but to cancel all space shuttle activities. Galileo was returned to the Jet Propulsion Laboratory in storage.

Several changes were made to Galileo because of the *Challenger* accident. The Centaur upper stage, nicknamed 'The Death Star' by the astronauts, was cancelled and the Inertial Upper Stage (IUS) was to be used instead. If the Centaur was used, it would have taken Galileo two and a half years to reach Jupiter directly.

These changes led to the design of a new interplanetary flight path which would use the 'gravity assist' technique to build up speed so Galileo could reach Jupiter. Galileo would use the Venus-Earth-Earth-Gravity Assist or VEEGA and would take six and a half years to reach Jupiter, encountering the above planets on its way there.

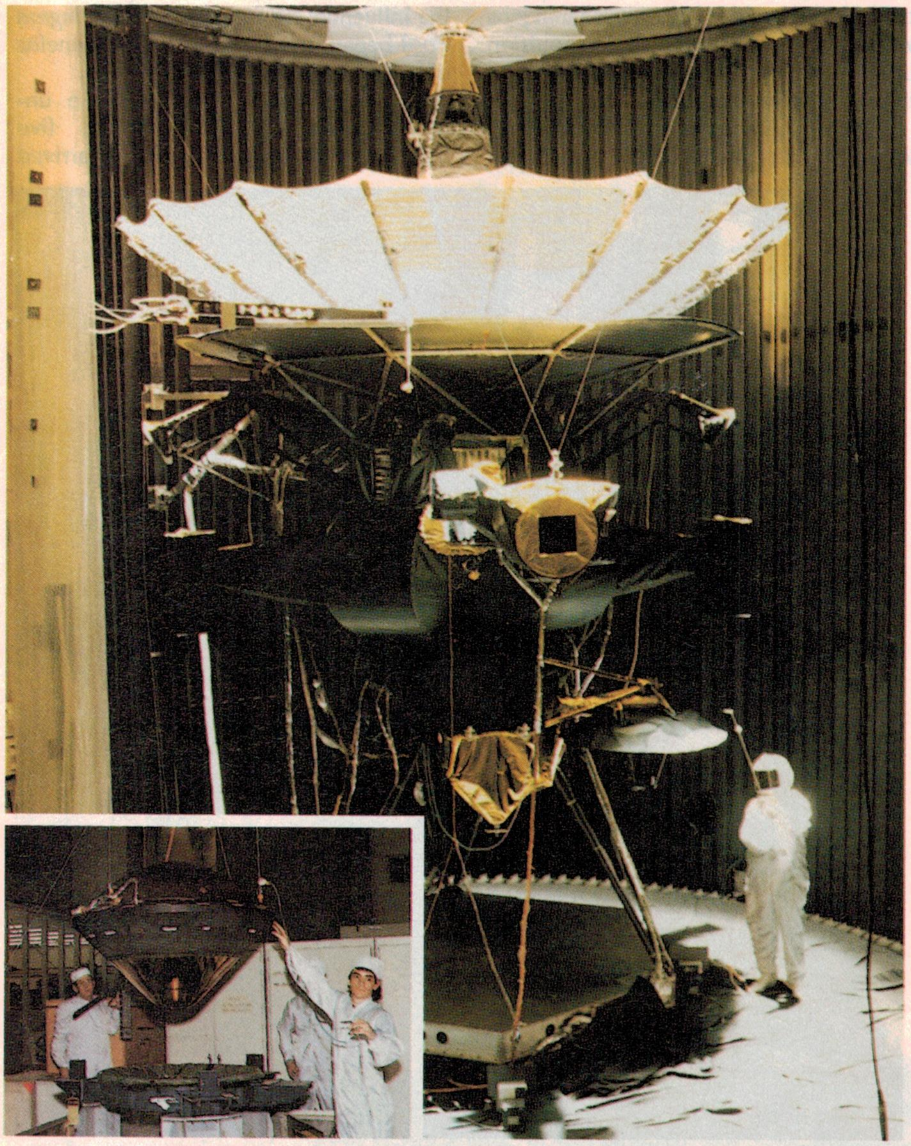
The planet Jupiter is the largest planet in our Solar System. Earlier spacecraft visiting the planet had found it to be a whirling ball of liquid hydrogen and helium, with a colourful atmosphere comprising gaseous hydrogen and helium.

Ammonia ice crystals form the white Jovian clouds, while sulphur compounds produce the brown and orange colours seen in the atmosphere. Scientists think that methane, ammonia, water and other gases react to form organic molecules in the regions between the planet's cold cloud tops and the warmer hydrogen ocean lying below. Because of Jupiter's atmospheric dynamics, it is suspected that these molecules (if they exist) are very short lived.

One of the highlights of Jupiter's appearance is the Great Red Spot — a cyclone like storm in the planet's atmosphere, more than twice the size of Earth. The Spot, which has been observed for centuries, spins in a direction opposite to the planet's rotation and the storms that take place in the atmosphere.

Jupiter takes 12 years to orbit the Sun and has 16 known moons, the most interesting being Io, a 'hell hole' of sulphuric volcanoes that spurts debris up to six hundred kilometres out into space.

Jupiter has been previously visited by four spacecraft. Pioneer 10 in 1972 and Pioneer 11, the next year were the first to fly past the planet. In 1979, the Voyager 1



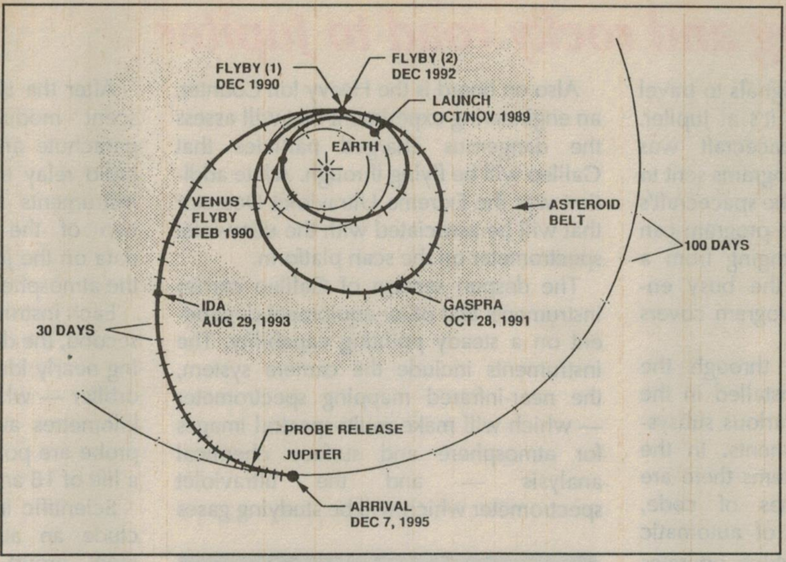
***Here Galileo is shown being prepared for environmental testing in the solar/vacuum space simulator at JPL, where it was built. Because of size limitations, the booms cannot all be fully extended. Inset: the atmospheric probe being prepared for system testing. It is enclosed in its aeroshells which will protect it during atmospheric entry and aerobraking.***

and 2 spacecraft encountered Jupiter and its moons. Apart from discovering in March 1979 that Jupiter has a ring system around it, the Voyager 1 spacecraft discovered active volcanoes on Io that were still erupting when Voyager 2 visited four months later.

The Galileo spacecraft was designed to investigate three broad aspects of the Jovian system: the planet's atmosphere, magnetosphere and moons.

Galileo was constructed in three segments, one being the spinning main section of the orbiter which contains the main communications antenna, propulsion module, flight computers and scientific support systems.

The non-spinning section of the orbiter carries cameras and remote sensing equipment. The last segment is an atmosphere probe that will descend into the Jovian atmosphere in December 1995.




***Galileo's flight to Jupiter is planned so that it achieves three boosts from gravity — twice when it flies past Earth, and a third time when it flies past Venus. This diagram shows the idea.***

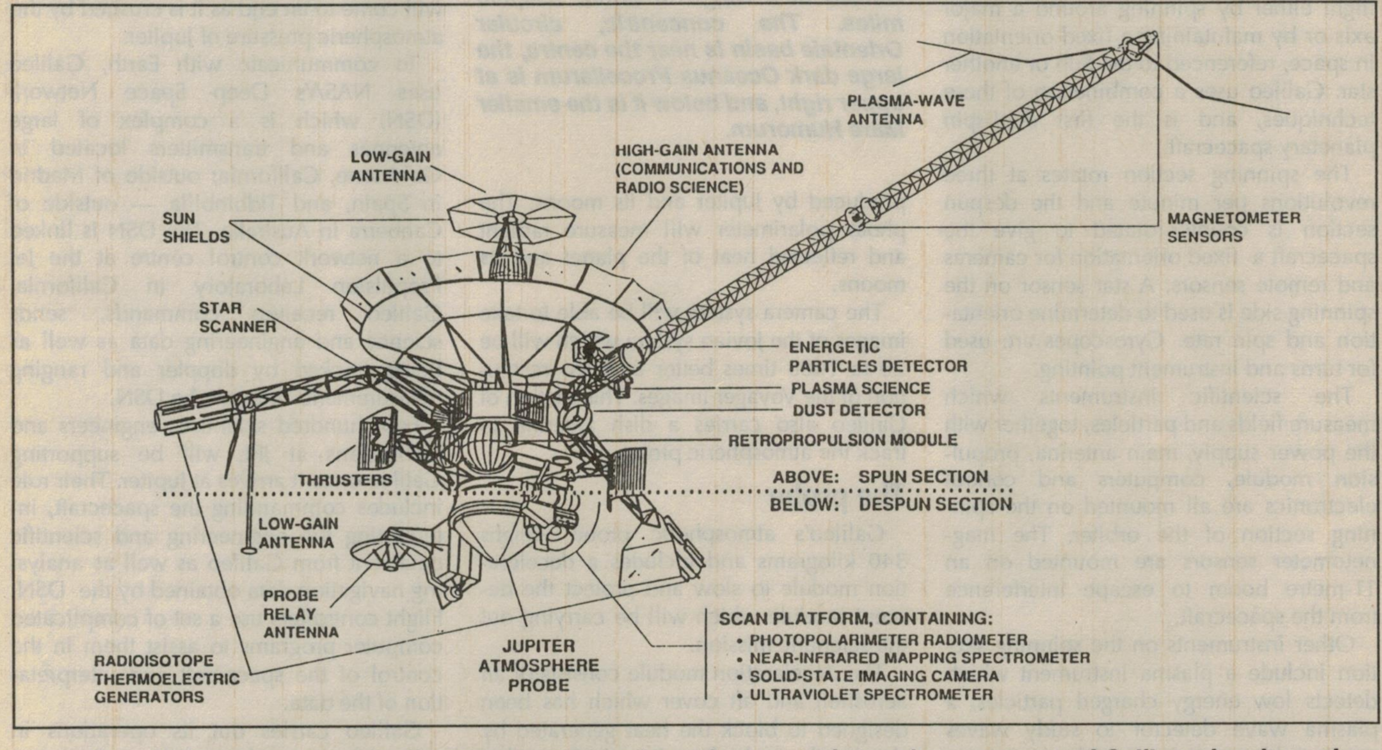
## Technical data

Galileo is five metres wide and 9.2 metres tall. The spacecraft weighs in at 222 kilograms and includes 925 kilograms of rocket propellant. The propellant will be used for small manoeuvres in its journey to Jupiter and to insert the spacecraft into orbit around the planet. The propulsion module comprises twelve 10-newton thrusters, a single 400-newton engine, a fuel oxidiser and pressurising gas tanks, tubing, valves and control equipment. The system was built by Messerschmitt-Bolkow-Blohm in Germany.

Galileo has a communications rate of 134 kilobits per second. There are other data rates down to 10 bits per second for transmitting engineering data, for times when the Earth-Galileo geometry makes communicating with the spacecraft difficult. The spacecraft acquires and transmits a total of 1418 engineering measurements which include voltage, temperature and computer states. Galileo transmits on a frequency of 2295 megahertz in the S-band and 8415 megahertz in the X-band.

The spacecraft has an umbrella-like high gain antenna (HGA) measuring 4.8 metres wide. Two low gain antennas (LGA), one pointed forward and one pointed aft, are both mounted on the spinning section of Galileo.

These two antennas are used to support communications during the Earth-Venus-Earth section of the flight, or when the main antenna is not deployed. The non-spinning section of the spacecraft carries a radio relay antenna for receiving data from the atmospheric probe.




***Taken from NASA literature, this diagram shows the planned construction and components of Galileo when its various antennas and sensor arms are deployed. Note that in reality, the large high gain antenna dish has not correctly unfurled — despite a number of attempts to make it do so. Alternative ways are being explored to transmit back the data.***

# Galileo's long and rocky road to Jupiter

It will take an hour for signals to travel to and from Galileo when it's at Jupiter. Because of this, the spacecraft was designed to operate from programs sent to it in advance and stored in the spacecraft's memory. A master sequence program can cover periods of time ranging from a week to months. During the busy encounter periods, a single program covers only a few days.

The sequences operate through the flight software, which is installed in the spacecraft's computers in various subsystems and scientific instruments. In the command and data subsystems there are approximately 35,000 lines of code, which include 7000 lines of automatic fault protection software which operates to put the spacecraft in a safe state if an unfavourable event such as a computer breakdown was to take place. The articulation and attitude control software is a further 37,000 lines of code, which is devoted to fault detection and protection.

Galileo's electrical power is supplied by two Radioisotope Thermoelectric Generators (RTGs). Heat produced by the natural meltdown of plutonium 238 is converted to 500 watts of electricity to operate the orbiter and its equipment for its eight year long mission. Previous users of RTGs include the Pioneer, Voyager and Ulysses spacecraft.

Most spacecraft are stabilised during flight either by spinning around a major axis or by maintaining a fixed orientation in space, referenced to the Sun or another star. Galileo uses a combination of these techniques, and is the first dual-spin planetary spacecraft.

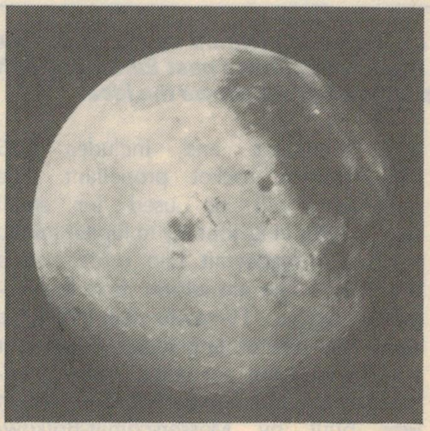
The spinning section rotates at three revolutions per minute and the despun section is counter-rotated to give the spacecraft a fixed orientation for cameras and remote sensors. A star sensor on the spinning side is used to determine orientation and spin rate. Gyroscopes are used for turns and instrument pointing.

The scientific instruments which measure fields and particles, together with the power supply, main antenna, propulsion module, computers and control electronics are all mounted on the spinning section of the orbiter. The magnetometer sensors are mounted on an 11-metre boom to escape interference from the spacecraft.

Other instruments on the spinning section include a plasma instrument which detects low energy charged particles, a plasma wave detector to study waves generated by particles, a high energy particle detector and a detector of cosmic and Jovian dust.

Also on board is the Heavy Ion Counter, an engineering experiment that will assess the dangerous charged particles that Galileo will be flying through. A late addition was the Extreme Ultraviolet Detector that will be associated with the ultraviolet spectrometer on the scan platform.

The despun section of Galileo carries instruments and other equipment dependent on a steady pointing capability. The instruments include the camera system, the near-infrared mapping spectrometer — which will make multi-spectral images for atmosphere and surface chemical analysis — and the ultraviolet spectrometer which will be studying gases produced by Jupiter and its moons. The photo polarimeter will measure radiant and reflected heat of the planet and its moons.



***This image of the moon was taken by Galileo at a range of about 350,000 miles. The concentric, circular Orientale basin is near the centre, the large dark Oceanus Procellarum is at upper right, and below it is the smaller Mare Humorum.***

The camera system will be able to take images of the Jovian system which will be 20 to 1000 times better than the resolution of the Voyager images. This section of Galileo also carries a dish antenna to track the atmospheric probe.

## The probe

Galileo's atmospheric probe weighs 340 kilograms and includes a deceleration module to slow and protect the descent module which will be carrying out the scientific mission.

The deceleration module consists of an aeroshell and aft cover which has been designed to block the heat generated by slowing the probe from its arrival speed of 220,000 kilometres per hour down to subsonic speed in less than two minutes.

After the aft cover is removed, the descent module deploys a 2.5 metre parachute and drops the aeroshell. The radio relay transmitter and the scientific instruments then start to operate and two of the instruments begin storing data on the journey from Jupiter's orbit to the atmosphere.

Each instrument operates at 128 bits per second, the dual L-band transmitters sending nearly identical streams of data to the orbiter — which by then is over 500,000 kilometres away. The electronics in the probe are powered by batteries that have a life of 18 amp-hours on arrival at Jupiter.

Scientific instruments on the probe include an atmospheric structure instrument group which will measure the temperature, pressure and deceleration rates. A neutral mass spectrometer and a helium abundance interferometer are used to support atmospheric composition measurements.

To measure cloud location, a nephelometer is used. A lightning radio wave emission instrument with an energetic particle detector will be measuring electromagnetic waves which are associated with lightning and energy particles in Jupiter's radiation belts. Another instrument on the probe is a net flux radiometer, which measures radiant energy flux.

After 75 minutes, the probe's journey will come to an end as it is crushed by the atmospheric pressure of Jupiter.

To communicate with Earth, Galileo uses NASA's Deep Space Network (DSN) which is a complex of large antennas and transmitters located in Goldstone, California; outside of Madrid in Spain, and Tidbinbilla — outside of Canberra in Australia. The DSN is linked to a network control centre at the Jet Propulsion Laboratory in California. Galileo receives commands, sends science and engineering data as well as being tracked by doppler and ranging measurements through the DSN.

Four hundred scientists, engineers and technicians at JPL will be supporting Galileo once it arrives at Jupiter. Their role includes commanding the spacecraft, interpreting the engineering and scientific data sent from Galileo as well as analysing navigation data obtained by the DSN. Flight controllers use a set of complicated computer programs to assist them in the control of the spacecraft and interpretation of the data.

Galileo carries out its operations in response to stored sequences which are sent up to the orbiter through the Deep Space Network in the form of 'command

loads'. Designing these sequences is a sophisticated process, balancing the desire to make scientific observations with the need to safeguard the spacecraft. Galileo regularly reports its status and health through an extensive set of engineering measurements.

In addition to the programs that operate Galileo, the mission operations team uses software amounting to 650,000 lines of programming code in the sequence design process. 1,615,000 lines of code are used in telemetry interpretation and 500,000 lines of code in navigation procedures. These codes are written, checked, tested and used in mission simulations before the launch of Galileo.

## More obstacles

After the return of the space shuttle to flight operations in September 1988, NASA announced that Galileo would be launched in October 1989 to catch the launch window for Jupiter of that year.

Scheduled for launch aboard the shuttle Atlantis from the Kennedy Space Centre on October 16 1989, Galileo had one final obstacle to overcome before launch — the American legal system. Several fringe environmental groups were concerned that the plutonium from Galileo could contaminate Florida and its surrounds, if there was a Challenger-like accident.

Accordingly they decided to sue NASA, to stop the launch and permanently cancel the project. A District Court judge who ruled in favour of the launch said that NASA had adequate safety precautions in place. In response to the ruling, several conservationists offered to sit on the shuttle launch pad at the moment of launch (!) but stringent NASA security ensured that no one was within seven kilometres of the area.

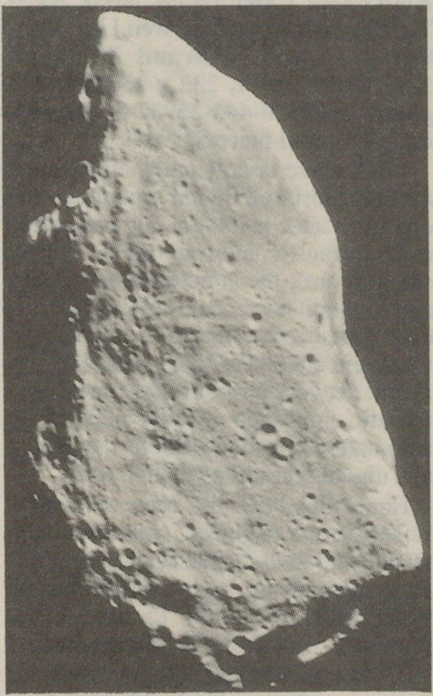
## Launched at last

After a delay of two days due to thunderstorms and rain, *Atlantis* was launched from KSC on 18 October 1989. Six and a half hours into the flight, the STS 34 crew deployed Galileo from the payload bay to begin its six year flight to Jupiter.

Five months later, Galileo arrived at Venus, and flew to within 16,000 kilometres of the planet. During the close approach, the spacecraft took measurements for dust and magnetism, took infrared and ultraviolet spectral observations and took 80 images of the planet. The data was recorded to be played back during the Earth encounter later that year.

During December 1990, Galileo made its first Earth flyby. After passing over Australia and Antarctica, the spacecraft made observations and measurements of the north polar region of the Moon, which is not visible from Earth. At the same time, Galileo also dumped its Venus data.

Trouble struck the mission on 11 April 1991. Flight controllers at JPL ordered the spacecraft to unfurl the high-gain antenna (HGA). The action was to be completed in less than 10 minutes, but micro switches indicated that the antenna was not fully opened.



***The asteroid Gaspra as viewed by the Galileo spacecraft in October 1991. Galileo was 5,300 kilometres away from Gaspra when this image was taken.***

The antenna, which is a modified version of the same design used by the Tracking and Data Relay Satellite, has a surface constructed of gold-plated molybdenum wire woven into mesh. This mesh is stretched across 18 graphite epoxy ribs and connected with elastic bands.

Antenna unfurling was driven by a set of redundant motors which turn a worm gear. This gear then pushes levers which spread the antenna's ribs. The HGA had been stowed behind a sun shield since launch, to protect it from the Sun whilst it was flying close to Venus and Earth.

JPL controllers since that time have been using a variety of methods to free the antenna. These included 'hot' and 'cold' soaks, when the spacecraft was turned to and from the Sun in an attempt to open the antenna.

It was suggested that a small relay satellite be sent to Jupiter to enable full communications with the spacecraft, but nothing was done about that plan.

In October 1991, Galileo made a close encounter with the asteroid Gaspra flying to within five thousand kilometres of it. Several images were returned of the asteroid via the low-gain antenna, but the majority of data was saved until it could be dumped during the second Earth flyby in December 1992.

The second Earth flyby by Galileo took place on December 8 1992. Spacecraft instruments used the flyby as a trial run for Jupiter observations such as looking at the dark side of earth to detect phenomena such as auroras, volcano glows, city lights and lightning.

Instruments were used to measure the Earth's plasma and magnetosphere through the solar wind bow shock. Galileo also used the flyby to take a time lapse movie of the Moon crossing behind the Earth.

Again, JPL flight controllers attempted to free the main antenna by soaking it in the Sun's light. The antenna's motors were turned off and on in an attempt to 'hammer' the ribs free. Higher temperatures increased the motor torque to relieve the friction of the ribs.

## Fallback plan

At the time of writing (February 1993), the antenna has not been freed. There are now plans to devise data compression and coding techniques, so that the data would be returned to Earth through the low-gain antenna.

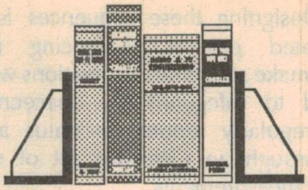
Improvements would be made to the Deep Space Network's antenna so that 70% of the science value of the high-gain antenna mission can be salvaged. It is also possible that NASA could use the Russian equivalent of the DSN to get further data from Galileo.

Even though there are problems with the antenna, Galileo is on schedule to encounter the asteroid Ida on 28 August 1993. In July 1995, the probe will be released from the orbiter and begin its journey to the Jovian atmosphere.

December 7 1995 will see the arrival of Galileo at Jupiter, when it will begin a 22-month, 10-orbit tour of the largest planet in the Solar System and its moons. A new Galileo will then rewrite the astronomy textbooks as its namesake did way back in the 17th century.

*In concluding, the author wishes to thank Mary Hardin of the Jet Propulsion Laboratory and Ken Stone of the Australian Space Office for their assistance in the completion of this particle. The photographs reproduced are courtesy of NASA and the Hughes Aircraft Company.* ❖

# NEW BOOKS



## Radio, TV guide

**1993 WORLD RADIO TV HANDBOOK, edited by Andrew G.Sennitt. Published by Billboard Books, 1993. Soft cover, 230 x 145mm, 608 pages. ISBN 0-8230-5924-3. Recommended retail price $39.95.**

The 1993 edition of the well-known WRTH gives a mountain of information for anyone who wishes to 'listen to the world'. It gives the world's broadcasters and their services, listed by country, plus an hour-by-hour guide to their broadcasts in English directed to your area, along with essential station information.

The information gives includes frequencies, transmitter power, operating times, languages, addresses, etc. There is also a listing of stations in frequency order to help you identify them more easily, along with maps of principal transmitter sites worldwide.

Other useful information includes names and addresses of international radio listeners' clubs, information on reception conditions, and annual test reports on receivers for the international listener. Also included are details of long, medium and shortwave broadcasters; of AM and FM transmissions; and both terrestrial and satellite TV.

The WRTH is very easy to use, and would be a very useful reference for anyone who enjoys listening to overseas broadcasts.

The review copy came from Dick Smith Electronics, and it is available from all DSE stores. (P.M.)

## Analog testing

**TESTING AND DIAGNOSIS OF ANALOG CIRCUITS AND SYSTEMS, edited by Ruey-wen Liu . Published by Van Nostrand Reinhold, 1991. Hard cover, 235 x 155mm, 284 pages. ISBN 0-442-25932-8. Recommended retail price $119.95.**

While there is now automated testing and diagnosis of digital electronic circuits, the same is not true for analog circuits. Because analog circuits are usually small in size, the engineer's experience and intuition have been sufficient. However, the current trend to use analog/digital hybrid circuits in VLSI chips (e.g. for neural networks) means that a more systematic approach is now needed, to automate the testing of both the analog and digital sections of such hybrids.

Hence this book has been written for scientists and engineers concerned with testing and fault diagnosis of analog circuits and systems. It covers fundamental principles, solutions to bottleneck problems, with realistic illustrations.

The book is divided into two parts: the first seven chapters deal with fault diagnosis of analog electronic circuits, while the last three are concerned with testing.

The text is clearly aimed at the specialist, with chapters devoted to such topics as: A circuit theoretic approach to analog fault diagnosis, Linear vs. nonlinear methods and Topological testability conditions. Each chapter contains examples, relevant mathematics and an extensive list of references.

The final chapters cover automatic testing for control systems conformance and analog integrated circuits, and a unified theory on test generation for analog/digital systems.

Definitely a text for the experts!

The review copy came from Thomas Nelson Australia, 102 Dodds Street, South Melbourne 3205. It is available through technical bookshops. (P.M.)

## Soldering 'bible'

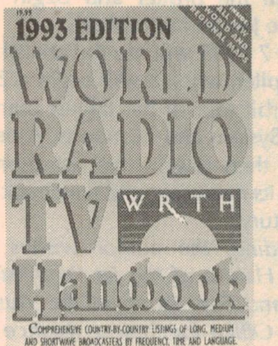
**SOLDERS AND SOLDERING, by Howard H. Manko. Third edition, published by McGraw-Hill, 1992. Hard covers, 236 x 160mm, 486 pages. ISBN 0-07-039970-0. Recommended retail price $105.00.**

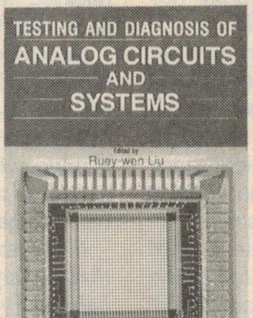
The latest edition of a well-known book that has become an international reference on soldering technology, since it first appeared in 1964. The author has degrees in chemistry and metallurgy, over 30 years experience in the field (with companies such as IBM), and with over 80 papers published is an acknowledged world authority on the subject.

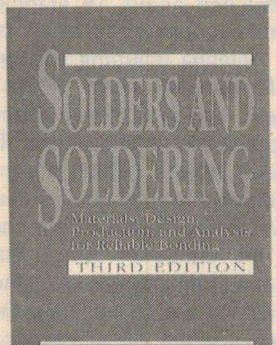
New sections included in this third edition include a chapter dedicated to solder pastes and preforms; an enlarged chapter on hand soldering for installation, touch-up (rework) and repair; a chapter on cleaning materials and processes (with emphasis on environmental and safety issues); and a coverage of the most recent quality control, inspection and testing procedures. This is in addition to the wealth of reference information given in the earlier editions, which covers virtually all aspects of soldering theory and practice: cleaning, fluxing, solder metallurgy and chemistry, heating systems, soldering tools and systems, bonding, specialised types of soldering (aluminium, silver, brazing) etc..

It really is a most comprehensive and thorough reference book, covering virtually every aspect of this technology. This latest edition therefore belongs on the reference shelf of anyone who *really* needs to know about soldering.

The review copy came from McGraw-Hill Australia, of Box 239, Roseville 2069. However copies should be available from technical and larger bookstores. (J.R.) ❖



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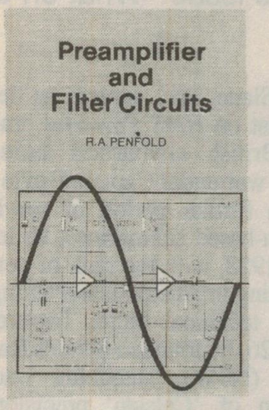


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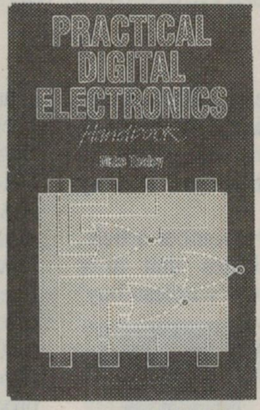


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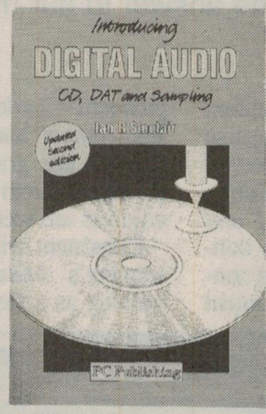


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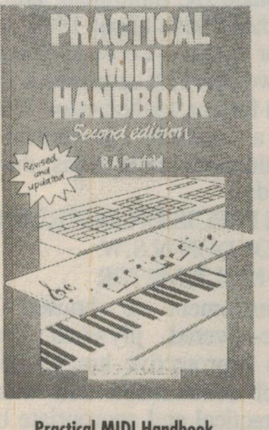


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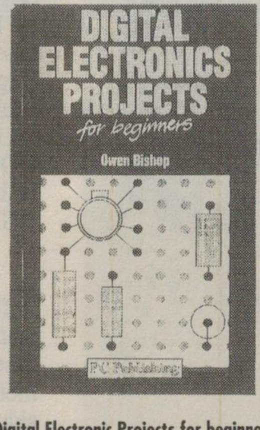


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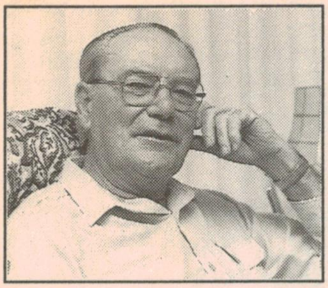


# When I Think Back...

by Neville Williams

## More about Charles Slade, the 'tropodyne' — and what about Fred Paton?

**That many readers learned to measure electrical properties with 1930's style Australian-made test equipment is evident from the comments which followed our observations on Slade's Radio in the November 1992 issue. In this follow-up article, we present a more intimate glimpse of the late Charles Slade — plus, for good measure — a biographical note about his contemporary, Fred Paton. Ah yes, and the answer to our rhetorical question in the same issue: 'What on earth was a tropadyne?'**

First off, aware that information about Charles Slade was both sparse and scattered, reader Gavin McLeod of Comboyne NSW made available a copy of Mingay's *Radio Trade Annual and Service Manual* for 1939, which contained biographical notes on the two contemporary Australian instrument pioneers: Charles Slade and Fred Paton. The *Annual* had originally belonged to Gavin's late grandfather, whom he held in high esteem as a true-blue country wireless serviceman.

Consistent with our November article, Mingay's *Annual* indicates that after training as a Royal Navy 'wireless boy' Charles Slade had served as leading telegraphist on *HMS Powerful*, transferring to British submarines during the 1914 - 18 war under Captain Boyle VC.

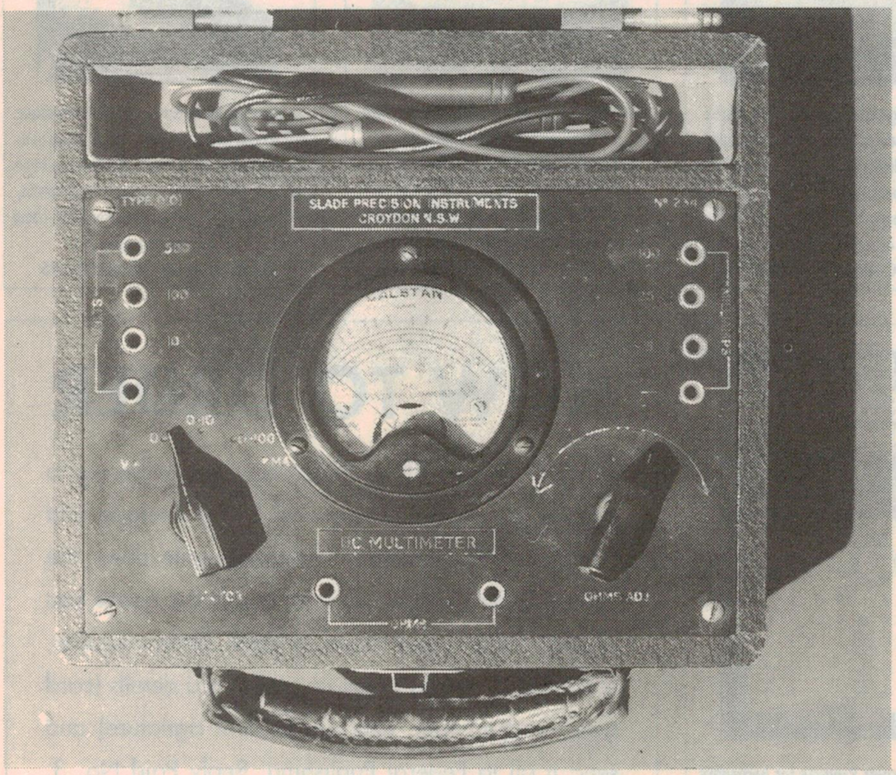



**Fig.1:** ***An original Slade/Calstan multimeter from the early 1930's, offering many Australasian enthusiasts for the first time current, resistance and voltage measurements — the last named at 1000 OPV (ohms per volt).***

After a further period of service in Australian-based submarines, he left the Navy in 1922, with the rank of petty officer, settling in Australia and taking up a career in technical radio. Towards the end of 1926, he founded Slade's Radio in Croydon (NSW), launching into the production of 'Calstan' precision test equipment in 1931, in subsequent competition with Paton Electrical ('Palec') based in nearby Ashfield.

Thanks again, Gavin, for your kind assistance.

I am also indebted to W.H. (Bill) Stacey VK4WHS of Maryborough in Queensland, for photographs of an original Slade DC multimeter purchased by his father "back about 1935, give or take a year or two". Looking closely at it (Fig.1) I wouldn't be surprised if it dated back even further, to the period 1931-33.

Using a 'Calstan' movement with VOM multimeter calibrations, the panel is branded:

SLADE PRECISION INSTRUMENTS
CROYDON N.S.W.
DC MULTIMETER

The instrument is housed in a leatherette-covered plywood carrying case with a protective hinged lid — a method of construction that was considered practical and appropriate by just about every enthusiast that ever assembled his own test gear during that particular decade. The panel is of black,

polished 'bakelite', but lettered more neatly than was possible at the time for the average handyman.

Basic though it may have been by present standards, Bill recalls that his father's investment created a lot of interest at the time 'in this part of the world'. Up until then, Bill says, most radio enthusiasts had to get by as best they could, "with a screwdriver and a pocket type moving iron meter for testing batteries" — a remark that checks with my own observations in the November issue.

## Across the Tasman

Another radio history buff who professed a sentimental regard for early Australian instruments was Don Sutherland ZL2AJL, pictured on page 41 of the December 1991 issue. Don rang through from New Zealand, on the basis that it was easier to chat casually per optical cable than to compose a multi-page letter...

As a long-time enthusiast, Don said he was familiar with both 'Calstan' and Paton instruments but had finished up with a factory-built Paton multimeter in his collection, complete with the original user manual.

Passing mention that Slade's 'Calstan' brandname signified 'calibrated to standard' led to a chat about the uncertain accuracy of 1930's-style 'precision' meters and multimeters and, for that matter, of the 'standards' and/or transfer standards against which they were supposedly calibrated.

What really intrigued Don, however, were the directions in the Paton manual about what to do and what not to do, in the event of the meter movement being damaged by overload.

Purchasers were warned that they should never try to repair meter movements themselves, but return them to the manufacturer for repair and adjustment. The manufacturer could supply and fit a new pointer, new stop and balance components, new springs, even a new moving coil, the cost per item ranging from a mere 1/6 (one shilling and sixpence) to around 2/6 (15 - 25 cents)! At the time, Slade's prices would presumably have been of the same order.

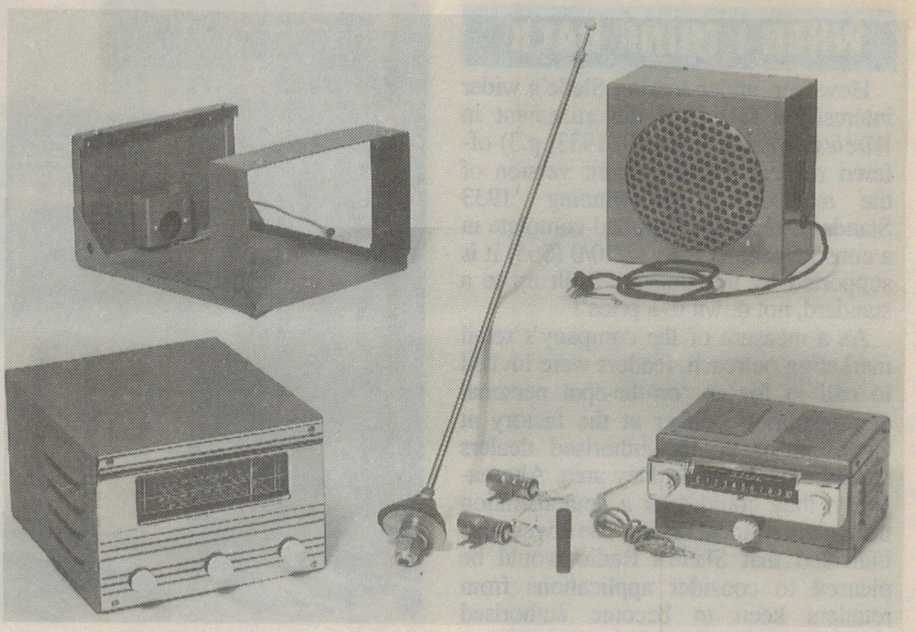


***Fig.2: (Clockwise from bottom left) The basic car/mains receiver, released circa 1955; the cradle which was mounted in the vehicle; the plug-in loudspeaker; and the control head of a quite different Slade/Weston car radio. In the centre are the car antenna and optional filter components.***

As I recall, despite these seemingly modest charges, many technicians chose to ignore such advice, taking it upon themselves to straighten or clear bent or 'sticky' pointers, re-adjust balance counterweights and re-set zero adjustments.

There were at least two reasons for this:

(1) To 'bash' a meter made one look and feel like a careless idiot. The ability to mend it on the spot tended to restore one's credibility!

(2) At a time when spare multimeters were a rarity, returning one for repair posed the problem of how to get by in its absence.

I must confess that, in my day, I've bashed my share of meters and mended my share of pointers — but I also learned never to mess with suspension springs. What a boon it was when emerging technology made it possible to render meters more idiot proof!

## Only a sideline

Such matters aside, our November article carried the clear implication that, while Charles Slade is widely remembered as a pioneer of Australian test equipment, his business activities, in reality, had more to do with the manufacture and supply of semi-customised receivers and related components. A further letter — with enclosed photostats — from the indefatigable Darryl Kasch of Maryborough, Qld, provides additional support for this observation.

A photostat from *Radio Retailer of Australia* (November 1, 1935, p.17) showed the kind of advertisement one might expect to see for Slade's Radio in the mid 1930's. Targetting dealers and servicemen, it assured them that Calstan's current type-203 valve testers, whether mains or battery powered, would accept all popular types, including the new American metal 'tubes'.

### PATON OF PATON ELECTRICAL

**PATON, Frederick Henry**: Managing Director, Paton Electrical Pty Ltd, 20 Victoria St, Ashfield, NSW.

In 1910 joined Maritime Wireless Co, Randwick NSW and served four years apprenticeship. At outbreak of war joined field engineers and served at Gallipoli and in France, being severely wounded and eventually invalided home in 1917.

Interested in radio experimentally until taking it up commercially in 1929, making radio receivers and test equipment. Founded present company in May, 1935.

Private address 90 Victoria St, Ashfield. Born in Sydney 3/10/1895. Married; club: Amateur Fisherman's Association; recreation: angling.

However, under-scoring Slade's wider interests, a full page advertisement in *Wireless Weekly* (June 30, 1933, p.3) offered readers a factory-built version of the magazine's prize-winning '1933 Standard' receiver. Supplied complete in a console cabinet for £32/10/0 ($65) it is supported by the slogan: 'Built up to a standard, not down to a price'!

As a measure of the company's retail marketing outreach, readers were invited to call in for an 'on-the-spot personal demonstration', either at the factory at Croydon, or at 15 authorised dealers spread around the Sydney area. Alternatively, they could seek a demonstration through their local dealer. The advert also indicated that Slade's Radio would be pleased to consider applications from retailers keen to become authorised dealers in other territories.

Again, in the *Radio Retailer of Australia* (November 22, 1935) a half-page advertisement alerted readers — and especially dealers — that Slade's Radio had just released a new 'Calstan' 4/5-valve D/W model using the new 'Philips 4 volt Super Series Valves'. This was in addition to eight on-going models — D/W and broadcast, mains powered and battery operated.

Even more to the point, a quick check in the *1939 Radio Trade Annual*, mentioned earlier, indicated a startling 24 different models in the 'Calstan' range for that year!

Yet another photostat from Darryl Kasch indicates the breadth of Charlie Slade's interests in the 1930's by way of a 'letter from London', published in the *Radio & Electrical Merchant* for August 30, 1935. On an overseas fact-finding tour, he had evaluated the rival television systems being promoted in the UK by Baird and Marconi/EMI.

Having rejected outright the original 30-line technology, and after being televised by Baird's higher definition intermediate film system, he expressed himself as being quite impressed by Baird's then-current achievements — this at a time when accepted wisdom was to write Baird off as a tedious old-timer.

In all fairness, however, Baird's pioneering efforts circa 1930 had been so widely publicised that he tended to be 'stuck with' that image. In 1935, when visited by Charles Slade, and as evidenced by Baird's own lecture to the IRE World Radio Convention (Sydney, 1938), he was well aware of the need to achieve higher definition.

So much for Slade's Radio and Calstan pre-war.

*Fig.3: A 1956 model radiogram, fitted out and presented in a Slade cabinet, used a chassis designed and built by Zenith.*

## Slade after the war

John Tyler, who currently operates a radio and TV repair business in Drummoyne, NSW, rang to say that he had read with interest the article on the late Charles Slade in the November 1992 issue, but he sensed that my informants had not known Charles Slade at a close personal level. I agreed that such was probably the case, even though some had met him in the course of everyday business.

John said that he himself had joined Slade's Radio at apprentice level in 1954 and, working in the fairly confined atmosphere of a small home-based factory, had developed a close personal friendship with Charles Slade. He had also been at his bedside when he died, some years later.

While he had therefore not been involved in his early business career, he had gained some knowledge of it from casual conversation.

He understood that, back in England, while still a 'wireless boy' attached to the Royal Navy, a very young Charlie Slade had boarded with a Mr and Mrs Ashby — both about 12 years his senior — and got on so well with them that something akin to a parent/son relationship had developed.

After the war (WW1) Charles Slade and the Ashbys had both ended up in Australia and, by mutual agreement, he rented a room in their then conventional single-story cottage in Lang St, Croydon. It was from that same address that he operated the Croydon Radio Service.

Some years later, Mr Ashby took ill and died, but not before he had received a promise from young Charles that he would look after his widow; this was on the basis that her financial needs were already reasonably well covered. It was an undertaking that Charles Slade faithfully honoured, in what was effectively a mother/son relationship.

## From house to 'castle'

As the business grew, more space had to be provided at the Lang St address. John Tyler said that Mrs Ashby rather fancied herself as an architect, although she had no formal training in that field. Sufficient to say that, under her guidance, the original Ashby cottage gradually expanded outwards and upwards, until it assumed the proportions and appearance described in the November issue.

John Tyler says that, in his day, there were two separate factory areas. The 'No.1 factory', attached to the house, was the larger of the two and was used for equipment assembly and testing. The 'No.2 factory' was a separate outbuilding, set aside mainly for cabinet work and storage.

Questioned about the early production of meters and test equipment and possible co-operation with Fred Paton, John said that he could not add to what we had already said, beyond an observation that the No.1 factory could well have accommodated more bench workers than it actually did in the post-war era.

He went on to say, however, that the November article may well have overrated Charles Slade's technical contribu-

tion to the business. In his own day, he said, the design work was done mainly by people like Allan Ryding and Laurie Lawrenson. Other equipment was also bought in from time to time, which was re-badged and marketed as 'Calstan' or 'Slade'.

Searching through his papers, John came across some old snapshots of typical postwar Slade receivers but while there sufficient of them to indicate a variety of models, few were suitable for reproduction in the magazine.

One shown in Fig.2 is the AC/battery car radio receiver specifically mentioned in the November article. John Tyler says that it was actually designed and manufactured by Sel Weston, who older readers may remember as a one-time specialist in mobile vibrator-powered transceivers.

A lot of Zenith-built chassies also reached the market via Croydon, re-badged and presented as Slade. Fig.3 shows one of these, a 'radiogram'.

By contrast, a luxury receiver (Fig.4) released in 1954, featuring an open-reel tape deck, a Dual phono player and an in-built vented loudspeaker enclosure was home-grown Slade — even to the tape deck electronics.

Then again the Calstan B&W TV receiver, of which a couple of thousand were produced at Croydon, was basically an RCA design inherited via AWA and their components off-shoot companies MSP (Manufacturers Special Products) and AWV (Amalgamated Wireless Valve Co).

## 'The man up front'

Where Charles Slade stood out, according to John Tyler, was as a 'front man'. People visiting the Croydon premises normally found themselves talking to Slade himself. He came to be accepted not only as the boss, but as the man who had the answers! He had his idiosyncracies, for sure, but was well liked.

As to the financial structure of the business, it was unclear what proportion of it was owned by Charles Slade and how much by Mrs Ashby. Further to complicate the picture, shares were made available to trusted employees, of which John Tyler was one. Overall, however, the business suffered badly, postwar, from the indifferent health of the two principals.

Mrs Ashby, the older of the two, had long been diagnosed with heart problems and had the shorter life expectancy. However Charles Slade encountered a serious throat problem which was diagnosed in late 1960 at Guys Hospital, London, as throat/thyroid cancer. Back in Sydney, he underwent major surgery at Sydney's North Shore hospital, to little avail.

John says that he suffered serious respiratory problems and became increasingly dependent on oxygen therapy. One night in February 1962, John was called to Charles' bedside by Mrs Ashby and stayed with him as his life ebbed away. Some time later, Mrs Ashby also died and the scene was set for the ultimate dismantling of Slade's Radio, Croydon, by creditors as described in the November article by Kevin Piggott.

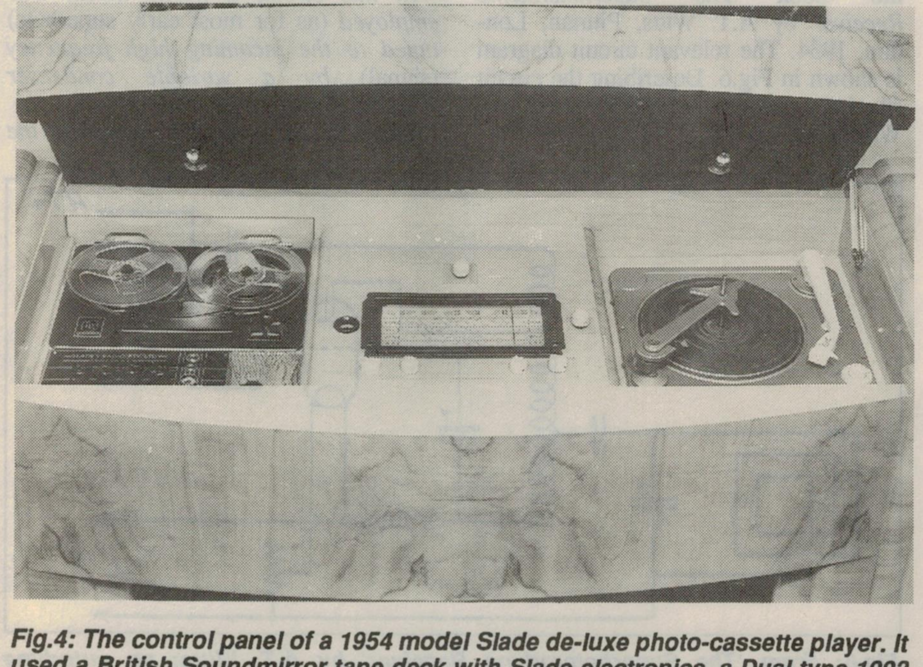


*Fig.4: The control panel of a 1954 model Slade de-luxe photo-cassette player. It used a British Soundmirror tape deck with Slade electronics, a Dual type 1002 phono deck, a Slade-built chassis and was fitted into a pretentious cabinet with an inbuilt loudspeaker enclosure.*

John Tyler says that, as a long-term employee and a residual shareholder, he might conceivably have sought to resurrect the business as a last resort; but there was literally nothing left to save. In the final crisis period, a debt of something like £200,000 had accumulated by way of unpaid sales and income tax (plus penalties), with a further substantial liability to local government, for rates and so on.

In effect, Charles Slade died without tangible resources and much the same would have been true of Mrs Ashby. The property, which still stands, was finally sold up, principally to offset local government liabilities.

John Tyler's reaction to all this was to set up his own business in nearby Drummoyne — but not without a thought for his former employer and long-time friend. Charles Slade's one-time business of 'Croydon Radio Service' was perpetuated in name only as 'Croydon Radio & TV Services' of Drummoyne, (02) 811 306.

Thank you, John, for your frank and caring contribution to the memory of a man who put the first decent meter on many a reader's test bench!

## Paton and 'Palec'

In so saying, I cannot but be aware that we owe similar coverage to Paton Electrical Pty Ltd, and its founder Fred Paton. A contemporary of Charles Slade, Fred Paton also produced many of the meters once treasured by Australian enthusiasts and, for me, my first laboratory-type standard signal generator — which I still have, complete with user manual.

Unlike Slade's Radio, Paton Electrical appears to have concentrated mainly on instrumentation but, beyond what one can deduce from advertisements over the years, the only actual documentation I have on hand is a brief biography of Fred Paton, published in Mingay's *1939 Radio Trade Annual*.

It is reproduced for your guidance in the accompanying panel.

(Perhaps I should mention here that I have heard reference to a 'Jack' Paton, but am unsure whether it signified an error, a familiar nickname or perhaps some other person altogether).

Possibly because of crippling war injuries, Fred Paton appears not to have been a very public figure but maybe — just maybe — one or more readers may have old magazine clippings on hand which relate to Fred Paton and his company.

## WHEN I THINK BACK

Even better, some readers may have worked for him during the 1930's, 1940's or 1950's, and/or known him personally.

But for publicity in the magazine, how else could we have made contact with Kevin Piggott or John Tyler — who, between them, have provided unique first-hand information about Charles Slade and his company?

If you can come up with clippings, photostats, illustrations or other information by way of a letter, about Paton/Palec, we'll do our best to organise it into a cohesive article.

### Meet the Tropadyne

In the November 1992 issue, I mentioned a little known, now long extinct magazine called the *NSW Wireless News*. On the cover of the August 18, 1925 issue was an advertisement for the Lincoln folding loop (or frame) aerial (Fig.5).

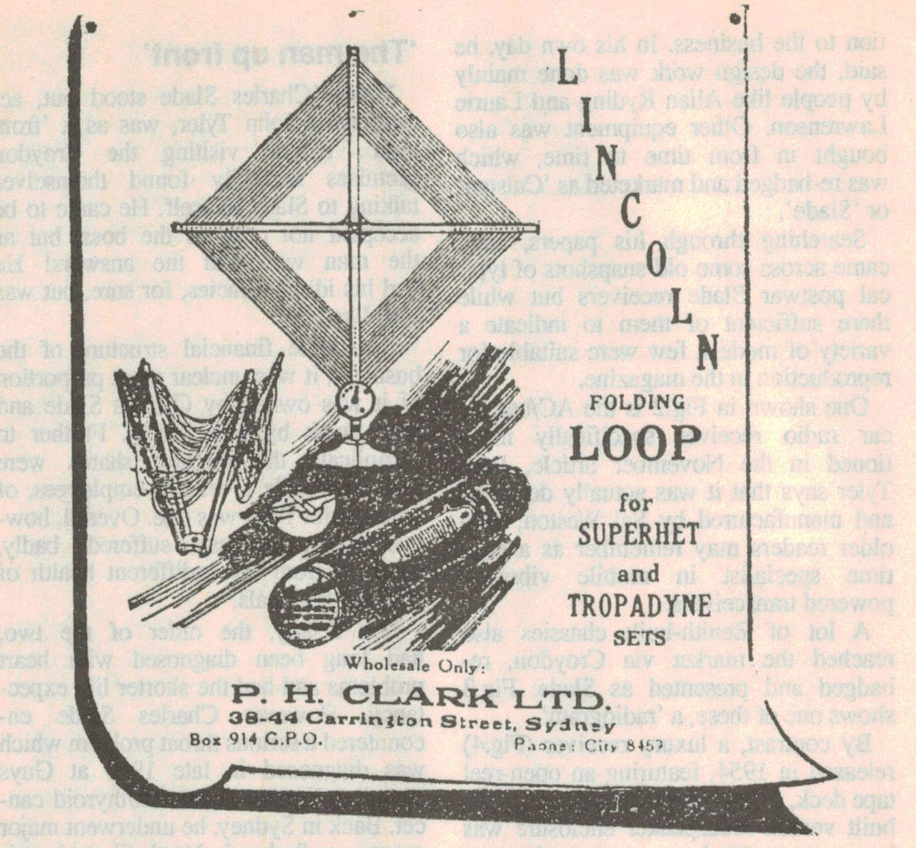



***Fig.5: The original advertisement for the 'Lincoln folding loop antenna', as published in 'New Wireless News' forAugust 1925. The tropadyne circuit itself must obviously be older than this again.***

I must confess that a folding frame aerial struck me as a potentially tangle-prone device, at best. More intriguing, however, was the statement that it was intended for use with superhet and tropadyne receivers. Hence my rhetorical question:

"What on earth is a tropadyne?"

As it turned out, an additional reason for the phone call from Don Sutherland, mentioned earlier, was to tell me that the term 'tropadyne' referred to an unusual 1920's-style battery powered superhet configuration which employed a filament-type triode as an autodyne self-oscillating mixer.

Prior to its appearance, separate oscillator and mixer stages had been regarded as mandatory in battery sets, to minimise interaction between the respective tuned circuits.

Autodyne frequency changers became routine during the early 1930's but they invariably used cathode and/or multigrid valves, which made it easier to isolate the two functions.

Even then, however, autodyne mixers proved unsuitable for multiband receivers where, on the short-wave bands, the high signal and oscillator frequencies were of a similar order, being only a few hundred kilohertz apart.

Don explained the tropadyne circuit configuration over the phone, leaving me to generate a diagram for publication as best I could. I needn't have worried, however, because the very next mail brought a letter and photostat which had been faxed to the *EA* office by Michael Eager of Brighton in Victoria. Michael is President of the Historical Radio Society of Australia, Inc.

The letter pointed out that the 'tropodyne' circuit — spelt with an 'o', as distinct from 'tropadyne' in the original advert — had been covered in the book *The Superheterodyne Receiver* by A.T. Witts, Pitman, London, 1934. The relevant circuit diagram is shown in Fig.6. Describing the circuit (the interpolations in brackets are mine), Witts says:

***How the tropodyne works:***

*Another circuit which was developed to enable one* (triode) *valve to be used as an oscillator and first detector* (mixer) *was known as the tropodyne and is shown in Fig.9* (6).

*In this circuit a frame aerial was employed* (as for most early superhets) *tuned to the incoming high frequency* (signal) *by a variable condenser* (capacitor) *connected across it.*

*The aerial circuit was coupled to the*

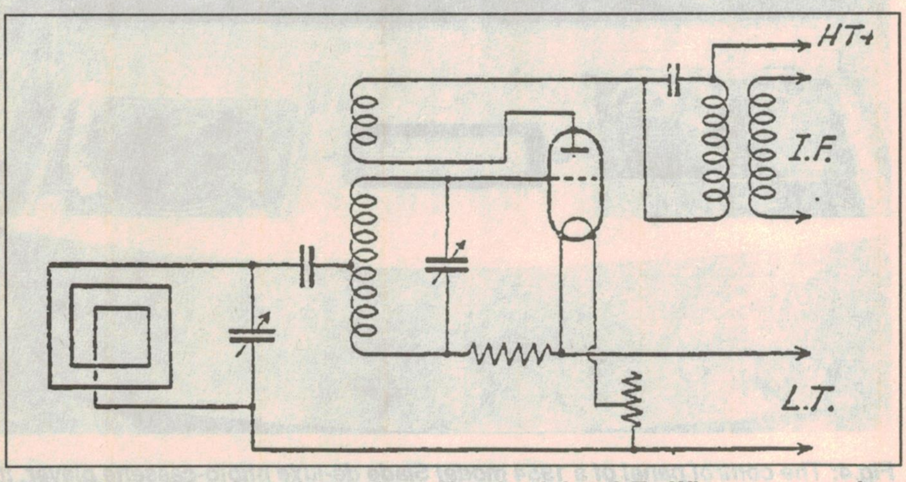



***Fig.6: From 'The Superheterodyne Receiver' by A.T. Witts: an autodyne frequency changer using a single battery triode, as used in the schematic for the tropodyne configuration.***

*valve input* (tuned) *circuit by a condenser* (capacitor, typically 250pF) *which at the same time acted as grid condenser for rectification purposes, the grid leak* (typically a 2 to 10M resistor) *being in the return* (path).

*This grid coupling condenser is connected to the electrical centre of the valve input inductance coil. The valve grid circuit is tuned to the* (appropriate local oscillator) *heterodyne frequency, and oscillations are maintained by feed-back from* (by means of) *a coil in the output* (anode) *circuit in the usual manner.*

*Reaction* (interaction) *between the aerial and valve input circuits is obviated* (minimised) *by coupling the aerial circuit to the nodal point of the input coil. Consequently the resonant frequency of either coil can be altered at will without the arrangement being thrown out of adjustment* (mutual 'pulling').

*As with Houck's harmonic heterodyne circuit, the serious loss of signal strength through de-tuning, which the autodyne circuit usually involves for superheterodyne work does not occur in the tropodyne, owing to the input signals being* (independently) *tuned in by the aerial circuit.*

What inspired the term 'tropodyne' is not stated, but it may possibly have been derived from 'troposphere', seen as a conduction path for long-distance signals.

It was a cunning arrangement, I must agree, although one point is noteworthy: because the grid/oscillator coil is centre-tapped, both ends and therefore both sides of the grid/oscillator tuning capacitor are active.

It would therefore need to be set well back on the baseboard and driven by a non-metallic spindle, to minimise hand-capacity effects.

Secondly, don't be mislead by the peculiar way the primary of the IF transformer is drawn. It carries current to the anode in the usual way and is shunted by a capacitor, which is certainly not usual in early superhets.

This reminds me of a remark by Don Sutherland that, as he recalls, tropodyne receivers used IF transformers which had inbuilt compression-type mica trimmers — perhaps confirmed by the capacitor in Fig.6. If they did, they would have anticipated the day when all IF transformers included provision for in-situ alignment.

Prior to that, early superhets appear to have been built around 'matched sets' of IFT's, which were/are presumed to have been self-resonant at or around some unstated supersonic frequency. ❖

## HAPPY WINNER OF THOSE H-P INSTRUMENTS

**Pictured is Mr Michael Fry, the winner of our recent subscriptions promotion, with some of his new Hewlett-Packard test instruments. Mr Fry tells us that he's a Guidance Officer with the private schools in the Mackay district of North Queensland, and also assists his home-base school's electronics project club. He has been an Electronics Australia subscriber for 15 years, and last year donated his collection of back copies to the school's library. He is understandably delighted with his win of over $11,500 worth of H-P test gear, and has plans to demonstrate it to the school's students — as well as using it for developing and testing his own projects. Congratulations again, Mr Fry!**

# THE SERVICEMAN

## *The computer I fixed — without knowing how or why!*

This month I'm going to give myself pride of place. I've completed two jobs that don't make any sense, so I think I deserve top billing for once. Neither of these jobs has earned me any profit; in fact the first one actually cost me, in both time and money. There's also a *really* scary story from a reader, about repairing an electronic flash unit with an intermittent fault...

I've told everybody I know that I will never-never-NEVER become involved with servicing computers. Even simple digital equipment is beyond my abilities, and I'd run a mile rather than get involved. I must admit, I have sometimes been conned into tackling a CD player. And I've even opened a computer power supply, but as that was only a simple switchmode unit, I did not break my vows by replacing the blown fuse.

However, as for getting stuck into the memory chips, or heaven forbid, the microprocessor, I said then and I will say again, No thanks!

So, after all that, why did I offer to look at my son's BBC microcomputer? I suppose because really, it wasn't his computer but mine! The story goes like this...

Just on 10 years ago, my son conned me into allowing him to spend all his savings on a BBC microcomputer, then one of the top selling small computers for schools and students.

He bought the computer and I bought the monitor, disk drive, printer, modem and word processing software. Since then, every word I've written for this and other magazines has been processed on the 'Beeb'.

I've used it for correspondence, newsletters, promotional material, accounts and book-keeping, and for dozens of other applications to which one can apply a small microcomputer.

I now have other computers for specialised applications, but for everyday use, this simple computer does everything I need around the house and office. In other words, it's become a vital part of my life and I'd be quite illiterate if the Beeb ever dropped its bundle.

Then one day, I was offered another BBC computer, complete with dual disc drives, memory expansion and a handful of EPROMs containing all sorts of interesting application programmes — the lot for $400. Considering that only a few years before I had paid out nearly $3000 for much less that this, it was just too good to refuse. I wrote a cheque then and there.

I had no immediate use for the second computer, but it provided a valuable backup for number one, if ever that fell over. The second computer and the other bits and pieces were stowed away in the garage, to provide spare parts if they should ever be needed.

Then a few months ago my son left home, and asked if he could take the spare computer with him. It wasn't an unreasonable request, since I had no immediate use for it. So No.2 was put back into service.

Except that it wasn't all that long before it was back again with the complaint that "...it didn't work!" More specifically, it would not change 'screen modes'.

The BBC micro was first released about the same time that British Telecom introduced their Prestel system, known in this country as Viatel. This used a 40-column text display and an array of simple but versatile graphics symbols, originally designed for the broadcast Teletext service.

This was adopted as the Beeb's standard display, and provision was made to allow the machine to be switched to a further six modes, encompassing 80-column text, graphics and mixed displays. This gave the Beeb an enormous versatility, at a time when other micros were struggling to incorporate a graphics display of any sort.

Software writers made full use of this versatility and many of their programmes switched modes several times in each line, to mix text and graphics and colour, to create displays that left the Beeb's contemporaries gasping.

Unfortunately, what had happened to my No.2 machine was that it had lost its ability to change modes. It would run perfectly in the 40-column mode (mode 7), but switching to any other produced only random text or garbage. I hadn't noticed this defect myself, because my favourite wordprocessor only uses the 40-column display.

So it came to pass that I was faced with the problem of sorting out why the computer would work perfectly in one mode, but not in any of the other six.

Fortunately, I had a copy of what passes for the circuit diagram of the computer. I won't try to describe it, but sufficient to say that it shows a nightmare of interconnections between empty boxes that represent the various chips that populate the board.

Only a few of the chips were labelled with their functions. The functions of

some others could be determined by reference to their part numbers, while many others were merely inscrutable black boxes put there by the manufacturer to confuse the poor flubbin' serviceman. (*Editor's Note: Obviously our Serviceman reads Tom Moffat's column...*)

I could identify the main CPU, a 6502, and another chip labelled as an SAA5050 which is also known as the Teletext character generator. Yet another chip was labelled 'Video Processor', and branded as an 'Acorn' proprietory type. Acorn is (was) the manufacturer of the Beeb, so this must have been their specialised video chip.

Applying all the simple logic I could muster to the task, I considered thus: the computer was working quite normally in mode 7, so most likely the central processor and the 40-column character generator must be working. And since it is most likely that the other modes, which are all unique to the Beeb, are generated in the (unique) Acorn video processor chip, then it is more than likely that the trouble with this computer lies in the video processing chip. QED?

There was one way to prove this hypothesis. Quite a few of the chips in this machine are socketed, including the video processor. I carefully removed the chip from the faulty machine and took it inside to the other (good) machine.

I swapped it for the equivalent chip from the working machine, which immediately became just as sick as the other. The illness looked somewhat different on the screen, but it was obvious that neither machine would work in anything but mode 7.

Which seemed to confirm that the video chip was faulty — and presented me with a real problem. Although Acorn computers are represented in Australia, I had no illusions that they would have a replacement for a specialised chip from a 10-year old computer.

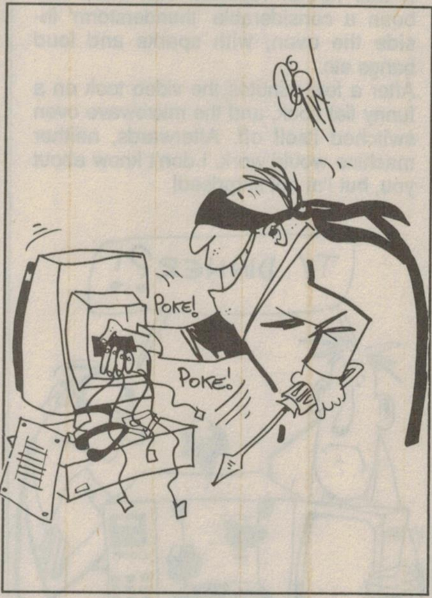
Instead, I wrote to a contact in the Victorian BBC User Group asking if he could help source a replacement chip. I hoped that one of his colleagues might have a junked micro that could supply the missing chip. It was a long shot, but it was all I had left. And that's where the problem stood for a week or two. I put the computer on the shelf and got on with some other work.

Then today, I was picking up some parts and stuff from one of my usual suppliers. And there, right in front of his cash register, were half a dozen tubes of 6502 microprocessor chips. They were on 'Special', at $7.20 each including tax!

The IC's were labelled as '8 bit, 1MHz' types and were being cleared as 'micro-controller' chips. I agreed with the '8 bit' part, but I was sure that they would run faster than 1MHz. I had no thought that they might cure the problem in my computer but I bought one, just the same.

And would you believe? It cured the problem. In spite of the fact that the video processor from the faulty machine would not run in the good one, there was nothing wrong with it. It seems the problem was in the CPU, which couldn't signal the correct mode in the video chip.

You can argue that I didn't really service the computer, but solved the problem by pure good luck. I'd have to agree with you, but then I still cured it — and half of all servicing jobs are fixed by accident, aren't they?




## Another fluke

The next job I want to tell you about was also fixed by an accident, but one of a different kind — I accidentally asked the right question of the right man at the right time. In fact, the story is about one of the strangest jobs that I've ever had in my workshop. It was strange because the cause and the cure were each totally inexplicable.

The job was a National video cassette recorder, a model NV-G22 and the complaint was that it would not play back the sound on its own recordings. According to its owner, it would play the sound on any other tape, either commercially pre-recorded or taped on another domestic machine. But when it was required to play back its own recordings, the sound would last for about five seconds and then cut out.

I confirmed most of what the owner said, with the slight exception that I found the sound to be rather more unpredictable. Sometimes it would disappear permanently, while at other times it was intermittent, coming and going at intervals of a few seconds or a few minutes.

Whenever the sound was intermittent, I tried the usual thump and bump routines; but there was no indication that the problem was caused by dry joints or loose contacts of any kind. I also tried heating and freezing around the audio circuitry, with an equal lack of success.

It wasn't until all of these common treatments had failed to yield any useful results that I sat down and really thought about the problem.

One thing I had noticed about the sound when it was intermittent was that it failed at different places each time I replayed the tape. This suggested that the sound had been properly recorded on the tape, but that the problem was one of difficulty with the playback.

I checked the dubious tape in another machine and sure enough, the sound was perfect. So the G22 was *recording* properly, but not playing back! Yet it had no trouble in playing back any tape that had been recorded on another machine. What was going on?

From a theoretical point of view, there should be absolutely no way the machine could tell whether it was playing its own recording or a pre-recorded tape. In the VHS system everything is very carefully standardised, for the very reason of interchangeability.

On the basis that the machine might be able to recognise its own recording by the thickness of the tape, I repeated the tests on a number of different tapes, from an E30 to an E240. I even tried a bit of tape from an ancient Philips NV1500 cassette.

In every case the machine knew that it had recorded the sound and played up accordingly. Yet when the same tapes were recorded in another machine, the G22 replayed them perfectly!

After many hours, spread over five days, I had been unable to find any mechanical or electrical fault with the machine. I was at a loss to know what to do about it.

I didn't want to tell the owner I couldn't fix his recorder, since that would mean quite a heavy financial loss. There was no way I could expect to recover my time in full, but if I could explain what was going on, I could at least recover something from the mess.

So I started asking around among my colleagues. In almost every case they were as puzzled as I was. I took one of the G22's cassettes with me and played

it back on machines in their workshops. There was nothing wrong with it and nobody could explain why it played so badly on the problem VCR.

However, one of my colleagues suggested that I change the pinch roller! He couldn't offer any reason why this should effect a cure, but he had solved other audio problems in the G22 by this simple remedy.

In the absence of any other explanation, I resolved to try his suggestion. Next day I fitted a new pinch roller assembly and, without much conviction, set about testing the machine.

I recorded half an hour of test pattern, then rewound it ready for the big test. Even at this point I was still unconvinced that I had done anything useful. But within five minutes I felt that we really did have a cure.

The machine was playing its sound without the slightest sign of hesitation. It played back that half-hour tape quite happily, so I fed it a two hour tape and set it to recording more test pattern. (It would have been more in keeping with the owner's style if I had recorded the afternoon 'soaps', but I had to listen to the audio playback and the soaps are not my 'cuppa tea'.)

I played that tape back next day, and it also appeared to run without problems. So I guess I can call the fault solved. But I don't know how or why! I still don't see how the machine knew the difference between its own and other tapes.

The only possible scenario I can think of is that the G22 has an audio record head that lays down a track somewhat narrower than that set by the VHS standard.

This would replay in any other machine but with a slightly higher signal to noise ratio. When replaying another machine's tape, the G22 would have a wider track to follow and any mistracking caused by a faulty pinch roller would not be a problem.

However, when replaying its own tape, much more precision would be needed to follow the narrower track. It would be easier for the head to run off the track and if the machine includes some kind of muting circuitry, then the intermittent sound noted earlier would be the most likely outcome.

I realise that this explanation calls for National to have fitted their machines with non-standard audio heads, a most unlikely occurrence. Yet it is the only one I can think of that fits all the symptoms. Can you think of a better explanation?

## Flash horror

At the head of this month's column I said that I had vowed never to be drawn into servicing computers and other digital whatsits. After reading the story that follows, I've added another device to the list of no-no's. It's not digital, but it's just as scary.

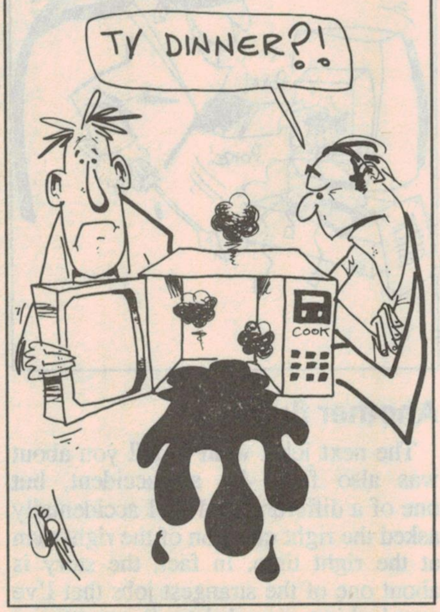
### More than just dry!

Launceston technician Robert O'Keefe rang recently to tell me about a customer who brought a badly melted video recorder into his shop. It wasn't so much that he wanted the VCR fixed, but more to explain why the accompanying microwave oven needed repairs.

It was alleged that there had been a lively party the night before, and someone spilled beer into the video. The party tapes that they wanted to watch must have been pretty exciting, because in an attempt to dry the machine quickly, the customer put it in the microwave.

It was further reported that there had been a considerable 'thunderstorm' inside the oven, with sparks and loud bangs etc.

After a few minutes the video took on a funny flat flook, and the microwave oven switched itself off. Afterwards, neither machine would work. I don't know about you, but I'm not surprised!




The story comes from B.H., of Heathmont in Victoria, and he tells it this way:

*Some years ago I decided to trade-up to a more modern automatic electronic flash unit, for my occasional forays into photography.*

*I eventually chose a National model PE-2850 unit. It offered a very satisfactory range of features for my use, and the specifications promised 200 to 1000 flashes from a new set of alkaline batteries when working in the automatic mode.*

*This flash unit exhibited a faint, high pitched whistle whenever it was charging properly. But gradually the recycle time increased until it took several minutes to recharge, while the whistle had changed to a low pitched growl. Finally, the unit stopped altogether and I knew that there was something drastically astray with its internals.*

*Before I could begin the repair, I had to open the thing. But how? There were only two small screws visible and all these did was to hold the flash tube housing to the main casing. I slid off the sensor unit, but this did not reveal any other fixings. The battery compartment slide cover hid a 'U' shaped spring clip, but removing this did nothing to allow the two half shells of the case to be separated.*

*I thought that moulded clips might be incorporated in the case, but firmly forcing the joins apart first with a knife and then with a small screwdriver failed to separate the half shells.*

*Finally, I prised off a small dial plate and found two small screws hidden underneath. Further examination revealed a square aluminium clip that was fitted over two spigots moulded into the case halves.*

*Removing the screws and clip allowed the shells to fall apart — giving access to two loosely held, very small PCB's and the already loosened flash tube. Around the PCB's were a dozen or so very thin connecting wires.*

*Before deciding to proceed any further with the repair, I decided to ask National if they could provide me with a copy of the service manual for the flash.*

*The company's staff were most cooperative, and later that week a full service manual arrived in the mail. I wish I had procured the manual earlier, because it explains disassembly and re-assembly with exploded diagrams which would have saved me much time and worry. It also contains a detailed fault/cause/remedy chart, as well as the usual circuit diagram and PCB pattern. In all respects it's an excellent service manual.*

*Working on this unit produces some special difficulties. When the case is in two halves, so is the battery compartment; and thus the flash cannot be turned on in the normal way. Instead, I used a variable DC power supply and clip-on leads to supply about 4.5V to the battery connections.*

*Incidentally, this flash normally runs*

*on 6V, provided by four AA cells. I chose to us a lower voltage for testing, as a precaution against developing excessive charge currents in the voltage multiplier section, when supplying current from such a low impedance source. To my astonishment the flash unit fired up perfectly, with its old familiar high pitched whine.*

*I could not find any obvious intermittent fault, so I carefully relocated the two PCB's into their correct positions within the half shells, prodded all the interconnecting wires into the available spaces, and retraced the entire assembly process.*

*With everything back together again, I inserted four new AA cells and switched on. Instead of the nice high pitched whine, I got the old familiar low growl — and no charge! I replaced the battery with the DC supply, but still the growl persisted. By this time I knew that I had a real intermittent. There was no other course of action but to dismantle the unit again and track down the intermittent fault.*

*After disassembling the half shells, I noticed a broken wire. After repairing this and re-connecting the 4.5V supply, the low growl persisted. But this time I noticed a short blue spark on the oscillator board.*

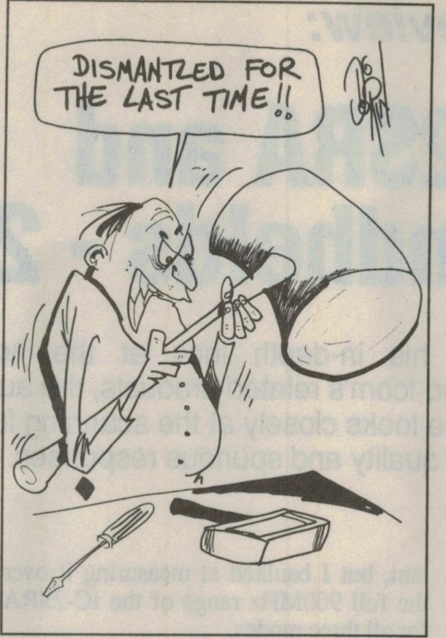
*After switching off, I examined the PCB in more detail and found a piece of the board between two closely spaced tracks to be slightly carbonised. It turned out that the tracks were a negative rail and the high voltage output from the oscillator. The latter track would have been carrying some 400V AC, so it was no surprise that arcing had occurred between the two. It was not a good piece of PCB design.*

*It was relatively simple to fix the fault, by scraping off the high voltage track altogether and making an 'aerial' connection above the board for the output from the oscillator transformer. This seems to have completely fixed the flash, and with 4.5V connected it fired up perfectly.*

*Unfortunately, before the job was put away I had a silly accident, which incidentally shows just how much grunt these little flash units can develop.*

*I tried to take a DC voltage reading at the storage capacitor, but slipped with the probe and lit the room up with a massive blue flash. The end of the probe had absorbed the full charge from the 700uF 330V storage capacitor. It was badly mangled, but there appeared to be no other visible damage.*

*Unfortunately, the slip had also taken out the oscillator transistor, and it was*




*10 days and 10 dollars before I could complete the repair. In the process three more of the hair-thin connecting wires had broken, and I was beginning to despair of ever having the pleasure of taking photos again.*

*Eventually, I had everything back together and the flash charging up with its usual whistle. But all was not well, since it would not flash when I depressed the test button. Nothing would make it flash, although the charge light was lit and everything appeared to be normal.*

*So again I had to go through the painful process of disassembly — only to be greeted by another broken wire which took a tortuous route down into the swivel mounting shoe assembly. This time I had to dismantle the shoe, and the National manual gave no instructions about how to do this.*

*Inside the shoe was a cunning arrangement of spring plates, a spring-loaded ball bearing and soldered connections. And it so happened that just at this moment my wife decided to vacuum the room. It's more than my life is worth to tell her to come back at a later time, so it was an hour later before I had re-connected the wire and reassembled the components back into the shoe.*

*All looked well, except that the ball bearing had no spring force behind it. I had supposed that one of the spring plates had applied force to the bearing but alas, this was not so. But where could be spring be? I had been so careful with the dis-assembly.*

*You've guessed it already. It had to be in the vacuum cleaner and sure enough, after I had emptied the bag onto a sheet of white paper on the garage floor, I found a tiny compression spring — all of 1.5mm in diameter and 5mm long!*

*With considerable glee I reassembled the intricate components into the shoe and retested the fitting. This time all was well and at long last the job was completed.*

*I know that VCR's and TV's have their hard-to-get-at PCBs and inaccessible places, but wait until you see inside one of these modern electronic flash units. And electronic cameras are something not even to be considered!*

*Still, if you are ever faced with a job like this, the best advice I can give is to not even think of starting without a copy of the service manual on the bench beside you.*

Thanks, B.H. I imagine that after your tale of woe most readers will hesitate and think deeply before tackling a flash unit. As I said earlier, these devices are now on my own banned list — although I'll probably get caught one day, just as I did with the computer that started this month's column!

## Fault of the Month

**NATIONAL CTV model TC1807**

SYMPTOM: Six or seven flickering lines at the top of the screen, similar to the teletext lines seen when vertical linearity is faulty. But in this case, the vertical linearity is perfect. The problem first appeared when the local channel extended its teletext coverage.

CURE: The trouble seems to be a design fault, with inefficient vertical blanking. This one was cured with a modification comprising a 1oouF electro fitted between B6 and IC301 pin 5, on the chroma board.

This information is supplied by ourtesy of the Tasmanian Branch of the Electronics Technicians' Institutde of Australia (TETIA). Contributers should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tas, 7015.

## Anecdotes wanted

Now, to finish off this month here's a word about the story in the box on the opposite page. It first appeared in TastroniX, the newsletter of the Tasmanian Division of TETIA. Our Editor fell off his perch laughing when he first read it, and says he still chuckles whenever he thinks about it.

So much so that he has suggested we begin a segment called 'Electronic Funnies' to feature amusing stories from our contributors. This will appear regularly if there is a suitable response, and we will pay $25 for each contribution used.

That's all for this month. I'll be back in thirty days, health and weather permitting. ❖

## Amateur Radio Review:

# Icom's IC-2SRA and related handhelds - 2

In this second instalment of his in-depth look at the new pocket-sized IC-2SRA VHF transceiver/wideband receiver and Icom's related products, the author examines the performance of the wideband receiver section. He looks closely at the scanning functions, the current drain, battery pack compatibility, receive signal quality and spurious responses.

**by LEW WHITBOURN, VK2ZIP**

The wideband receiver section of the IC-2SRA is a full-blown scanner with 60 scan/skip memories, two band-edge memories for program scan and even a call channel, which seems to be a genetic consequence of its amateur transceiver origins. Its nominal frequency coverage is 50MHz to 950MHz with a sensitivity of 0.56uV for 12dB SINAD in narrowband FM, 1.8uV for 12dB SINAD in wideband FM or 1.8uV for 10dB signal to noise ratio in AM mode.

The receiving mode (NFM/WFM/AM) is selected by a key labelled Mode at the top of the keyboard and is stored independently with the frequency when memorised. When the subaudible tone squelch (CTCSS) option (UT-63) is fitted, the receiver can be set up to open the squelch only if the received signal carries one of the 37 EIA standard subaudible tones between 67.0 and 250.3Hz, or 97.4Hz (a slight advance on the S-series, which had the 37 standard tones only). The subaudible tone status, tone and tone squelch On/Off is also stored independently in each memory.

I am not aware of this facility existing in any normal scanner, but it would be useful for determining the tones being used on particular frequencies. Tone squelch can in some circumstances be used to suppress the 'mute-tail' or 'squelch-tail' at the end of transmissions.

The existence of this feature in the IC-2SRA is almost certainly another inheritance from its amateur transceiver origins. The IC-W2A, to which it bears such a great resemblance, uses the same UT-63 tone squelch board (not supplied with either radio in Australia) to give independent tone encode/decode ability on both VHF and UHF bands — it is probably simpler to leave it in the IC-2SRA/4SRA than to take it out.

Receiver sensitivity is clearly important, but I baulked at measuring it over the full 900MHz range of the IC-2SRA for all three modes.

I chose to measure it for the narrow-band FM mode, which is the mode most widely used between 50 and 950MHz. But the results will clearly be indicative of performance on the other two modes, which according to the specifications should be 10dB worse.

Fig.4 shows the measured sensitivity of the receiver, for 12dB quieting (which is much the same as 12dB SINAD — unfortunately I can't do SINAD meas-

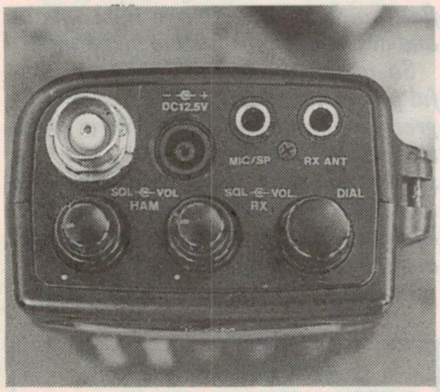



***Photo 2: The top panel of the IC-2SRA, showing the twin squelch/volume controls, the tuning knob and the various input and output connectors.***

urements). Over most of the range (say 100MHz to 750MHz) the sensitivity was a very respectable 0.3 to 0.4uV for 12dB noise quieting. It rises to about 1uV at 950MHz and about 0.7uV at 50MHz.

The receiver actually operates down to 25MHz, with gradually reducing sensitivity, as shown in the figure. The 3uV sensitivity at 25MHz is still usable, and would allow monitoring of strong 27MHz CB signals in AM mode (SSB is not provided). Note that, as discussed above, a sensitivity of 3uV on NBFM probably implies an AM sensitivity about 10dB worse, or about 10uV for 10dB signal to noise ratio.

The measurements presented in Fig.4 were made by connecting a miniature RG-174 50 ohm coaxial cable to a 3.5mm mono phono plug. Considering the good sensitivities measured all the way up to 950MHz it is clear that although the supplied antenna makes no connection on the earthy side, RF chassis earth must indeed be connected to the outer ring of the wideband antenna socket.

As well as sensitivity to the desired signal, Fig.4 shows the IC- 2SRA sensitivity to the image over the full range of the receiver. The corresponding measurements for the two-metre amateur band are also shown, labelled H. Features of the two curves are related to aspects of the receiver design as described below. Internally, it operates in four bands : 25 - 267.795MHz, 267.800 - 534.190MHz, 534.200 - 800.895MHz and 800.900 - 950.00MHz.

Most of the electronics of the receiver is common to these bands. The significance of the bands is simply that each one corresponds to a different front-end bandpass filter, designed to minimise broadband overload effects and minimise image response in the four frequency ranges concerned.

Fig.4 shows a sudden jump in sensitivity and image rejection between bands one and two at 266.8MHz and another lesser jump between 520 and 540MHz, which corresponds to the transition from band two to band three at 534.200MHz. There is a very large change in image sensitivity at this transition as well.

This is partly the result of a switch in band-pass filter at 534.200MHz, but it is

much more the result of the receiver jumping from high-side to low-side local oscillator injection at the same time. As the receiver tunes from 25MHz to 534.190MHz its local oscillator tracks 266.7MHz higher (i.e., from 291.7MHz to 800.890MHz), so that the image tracks two times 266.7MHz (533.4MHz) higher, from 558.4MHz to 1067.59MHz. Then, when the receiver tunes from 534.200MHz to 950.00MHz, its local oscillator tracks 266.7MHz *lower* — from 267.500MHz to 683.300MHz — while the image tracks 533.4MHz lower, from 0.8MHz to 416.6MHz.

Thus, as the radio steps from 534.190MHz to 534.200MHz its image jumps from 1067.59MHz to 0.8MHz. It is not surprising that the band three filter (534.2 to 800.895MHz) does such a good job of rejecting 0.8MHz! Even the 1nF input coupling capacitor probably contributes a few dB of attenuation at this frequency.

The reason for using both low-side and high-side injection is of course to minimise the VCO tuning range for a given receiver tuning range, and is a trick that Icom use to get extended receiver coverage throughout the S-series and W-series radios.

Note that in the upper part of its receiving range the wideband receiver uses its VCO up to 683MHz only, while it goes all the way to 890MHz in the lower range. This implies that the upper range could in principle go past 950MHz by the corresponding amount, i.e., at least another 200MHz.

Presumably this is another result of the similarity between the IC-2SRA wideband receiver and that in the IC-R1, which goes to 1300MHz. So I wonder if there is a place somewhere in the diode matrix to enable this extended coverage? Here is a challenge for the hackers!

## Scanning functions

Scanning operations for the IC-2SRA are the same for both the two metre and wideband receivers, the only difference being that the former has 30 memories while the latter has 60. There are two scan modes; program scan and memory scan, independently controlled for the two bands.

In memory scan, each receiver can scan its memories for occupied channels in the normal way. The wideband receiver has the additional feature that it can be programmed to scan through those memories set for any of the AM, NFM or WFM receiving modes; otherwise it stops at any occupied channel, regardless of its associated receiving mode. Individual memories can be marked to be skipped during memory scan.

***Photo 3: The IC-2SRA with the BP-82 battery pack on the right and the plug pack mains supply on the left. Visible at front left is the special power input connector.***

For programmed scan, each receiver has two additional memories for scan limits, PA and PB, which are stored like other memory channels, independently for the two bands. A very nice feature is that skip memory frequencies between the scan limits A and B are also skipped in program scan.

Additional skip frequencies can be created during program scan simply by pressing the F and V/M keys on any frequency where the scan pauses. The radio automatically stores these skip frequencies in the highest available memory channel and works its way down to memory 10. Thus there are 20 such skip memories for the two-metre receiver and 50 for the wideband receiver.

The beauty of this feature is that channels occupied by spurious signals, data channels, unmodulated carriers or otherwise boring signals can be readily locked out of programmed scan. No overwriting occurs during automatic skip channel storage, which therefore ceases when the available memories are all full. Some of these memories need to be erased manually if new ones are required.

I think it would be a slight improvement if the radio started overwriting, from the highest channel working downwards, once the scan skip channels were filled. Nevertheless this marvellous scan feature is the salvation of programmed scan, which is often rendered useless by boring channels in other radios.

As far as I know Icom is the only amateur transceiver manufacturer to give this feature. It has been incorporated into all of the S and W series transceivers, as well as the IC-R1 wideband receiver, and is available in only a limited number of dedicated scanners made by other manufacturers.

In all scanning operations the IC-2SRA allows choice of two scan-resume modes: PAUSE and 2-SECOND modes, which are set up independently in the SET modes of the receivers.

In PAUSE mode the radio pauses on an occupied channel for five seconds only, regardless of how long it is occupied. In 2-SECOND mode it resumes scanning two seconds after the channel ceases to be occupied, which is generally long enough to hold a channel during the normal breaks in two-way communications.

Scan steps of the IC2SRA are 5, 10, 12.5, 15, 20, 25, 30, 50 and 100kHz. (The 5 and 15kHz steps are not available for the wideband receiver for frequencies from 267.8MHz upwards.)

In addition there are dial select steps of 1MHz for the 2-metre receiver and 1MHz/10MHz for the wideband receiver. The inclusion of 30kHz steps is a welcome new addition, not available on the S-series and earlier series Icom radios and is great for VHF high band in Sydney.

I measured the scan speed of the wideband receiver to be 12-13 channels/sec on both programmed and memory scan. The two metre receiver scans almost as fast, at seven channels

per second in memory scan and 10 channels per second in programmed scan.

Overall, the scanning features of the IC-2SRA are excellent. The mode scan AM/NFM/WFM, CTCSS decode in the wideband receiver and the scan skip during programmed scan are really nice features.

I would prefer to see the two-metre receiver opened up for 138 to 174MHz coverage (instead of 144 to 148MHz), for several reasons. Firstly that would allow the 30 memories of the two-metre receiver to be used for scanning operations in VHF high band. Also, in some circumstances the superior 'communications quality' of the two-metre transceiver (e.g., greater sensitivity, better adjacent channel rejection and lack of birdies) could be used to advantage. In addition the use of the duplex feature of the two-metre transceiver may allow quick monitoring of repeater input frequencies, for example in the VHF marine band. (I was not able to test this, of course).

Failing this, wider coverage for the two-metre receiver would allow true simultaneous monitoring of repeater input and output frequencies throughout VHF high band, which would be very useful.

And finally, if I bought an IC-2SRA I would want to get everything I was paying for — the two-metre receiver is inherently a broad band design, with three track-tuned varicap stages in the receiver front-end. It is only an arbitrary decision by Icom to restrict the range to 144-148MHz for the Australian market — the only difference may be a couple of diodes connected to the CPU chip.

## Scanning curiosities

Two quirks of scanning are worth mentioning. Both apply to program scan, i.e, scan between limits PA and PB. The first is that when program scan is initiated it commences from the current VFO frequency to one of the program-scan limits PA or PB, before commencing cyclic scanning *between* the limits. This can be surprising and annoying, until you are aware of what is happening.

In the case of the wideband receiver, it may mean that the scan never actually gets to the intended scan range. For instance if you happen to be listening in the aircraft band 108-136MHz and decide to scan the 438 to 439MHz, which you may have already programmed, the radio has to scan from 100-odd to 438MHz before the desired program commences. Even if no interesting frequencies are encountered on the way, it still takes about 20 minutes to get to 438MHz!

I believe I can guess the origin of this peculiarity. On Icom's first scanning hand-held, the IC-02/04A(T) program scan always started at the lower scan limit. But this was *also* annoying.

I found that if I was scanning between, say, 450 and 470MHz on an IC-04A (yes, these receivers could be expanded quite easily) and wished to pause on an interesting frequency at, say, 455MHz, the only way to pause was to halt the scan. That was fine until I recommenced the scan, whereupon the radio would jump back to 450MHz. The result was that I never got through the intended scan range.

I think Icom engineers found the same thing, and programmed subsequent radios to start program scan

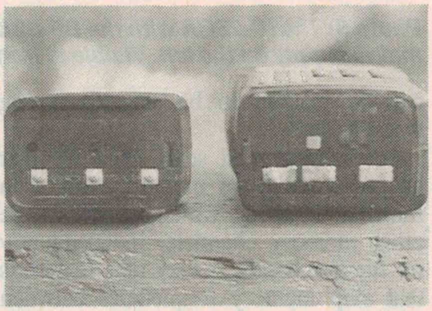


***Photo 4: The battery packs use three connections as shown here. This allows automatic setting of charging current, to suit each pack's capacity.***

from the current VFO frequency to overcome this annoyance. Every model since the IC-02/04A(T) that I have seen does just that. It is definitely an improvement, but I think Icom should add another line or two to their scanning software to ensure that program scan starts at PA if the current VFO frequency is not between PA and PB.

Other manufacturers, e.g., Standard, overcome this problem by having a separate 'scan-pause' function available during program scan, which would be equally acceptable. I remember that it was quite easy to modify the IC-02/04A(T) to give a scan pause function.

It was just a matter of using half the DPDT HI/LO power switch and a few diodes, to tell the microprocessor that the mute is open on low power. This gave a lovely scan pause function with no bad side effects. The same trick could be used on any radio having a spare switch, or room to fit one.

The second quirk of scanning that I wish to mention here concerns the scan-skip during program scan, which was described in detail above. Icom has programmed the scan skip in such a way that the radio still passes through the skip frequencies during program scan, but does not pause there if the channel is occupied. The result is that the mute opens briefly as the radio passes through occupied skip frequencies, which is very annoying. It is infinitely less annoying that it would be if the receiver stopped on an unwanted frequency, but it is still very distracting.

What is needed, of course, is microprocessor control of audio muting, regardless of squelch status. This may or may not be there already — it seems to me that it would be needed for memory scan — but in any case such a function needs to be used during scan through skip-frequencies. The problem does not arise during memory scan, of course, because the radio does not go through skip-frequencies in this case.

## Receiver current drain

Current drain of the two-metre receiver alone is 56mA, dropping to 17mA with a 1:4 saver cycle or 9mA with a 1:16 saver cycle. The 'on-time' of the saver is 1/8th of a second, so the 1:4 cycle checks for activity every half a second, which is a good compromise between high current (no saver) and a high probability of missing short calls with the two second time of the 1:16 cycle.

The current drain of the two-metre receiver with low audio output is about 75mA, rising to about 160mA at maximum audio.

Current drain of the wideband receiver is 88mA, dropping to 22mA with a 1:4 saver cycle and 9mA with a 1:16 saver cycle. The current drain at low audio is about 110mA, rising to about 180mA at maximum audio.

Some circuitry is of course common to both receivers, so the total current drain with both receivers on is slightly less than the sum of those given above. Current drains with no saver, 1:4 saver and 1:16 saver cycles are 140mA, 35mA and 15mA respectively.

The battery saver does not operate during scanning operations (a feature of the IC-R1 that has not been retained), so the supplied 300mAh BP-3 battery pack will last a maximum of about two hours with both receivers scanning, provided that not too many signals are encountered during the process.

## Battery packs

My choice of battery pack for this radio would be the 600mAh BP- 84, which is only 20mm longer than the BP-

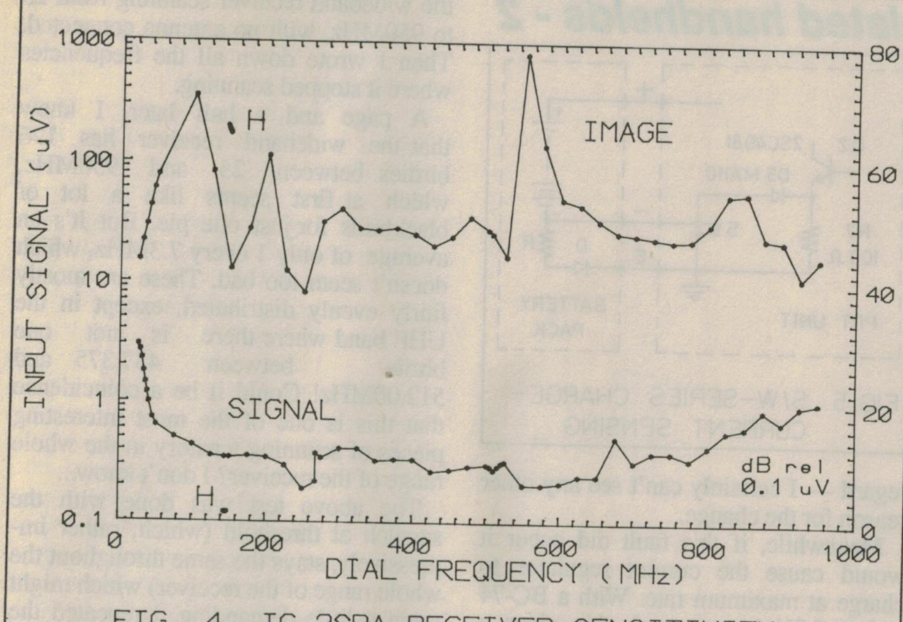



FIG. 4 IC-2SRA RECEIVER SENSITIVITY

83. A cheaper alternative would be the identical size BP-90 6-AA cell battery case, which is designed for nicads, filled with 700mAh AA cells.

As mentioned earlier, the entire S-series and W-series Icom radios use the same battery packs BP-81 to BP-90. All of these radios use identical external powering and battery charging circuitry. The only difference is that the W-series has abandoned the readily available 1.3mm coaxial DC power socket for a different kind of coaxial socket that I have not seen before, as shown in photos 2 and 3.

I am not aware of the name of this new plug/socket combination (if indeed it has a name — it seems to be an Icom original!) so it is hard to enquire after it with suppliers.

The only way to get an external power plug for the IC-2SRA is therefore to buy an OPC-288 external power cable (which comprises plug, cable and in-line fuse) for about $25 or the CP-13 cigarette lighter cable with noise filter which costs about $40.

The noise filter is a good idea but the cost of using non-standard plugs seems a little high, especially since I can see no advantage in the new plug style — indeed it has a very skinny centre pin and seems less robust than the traditional coaxial plugs which can be bought almost anywhere for less than $2.

Battery charging occurs whenever external power is applied to the radio using the supplied BC-74 wall charger, which has enough current capacity for powering the receivers as well — but not for transmitting, which requires up to 1.8A. The charging time for all battery packs (except the BP-85; see below) is 14 hours.

Apart from the traditionally expensive desktop charger (BC-72) for the S and W series radios, Icom offers the somewhat cheaper AD-20 battery charge adaptor, which is a cap just 10mm high that slides onto the top of the battery pack and accepts input from the BC-74 wall charger. This is a very useful option, not available for earlier (i.e., pre-S) series of Icom radios.

The only disadvantage of the AD-20 is that it uses the same non-standard socket as the W series radios, and will therefore only accept DC input from the BC-74, OPC-288 or CP-13. My choice would be to buy instead of the AD-20 the cheaper AD-14, which is the equivalent charging cap designed for the S-series radios. It is identical to the AD-20 except that it accepts the readily available 1.3mm DC coaxial plugs. Either way this allows charging of one battery pack while using the other, which is ideal.

To provide the different charging currents required by the different capacity battery packs that may be used, Icom use a three-terminal battery connection as shown in photo 4. Two terminals labelled + and - connect directly to the corresponding battery connections inside the battery pack. The third, labelled E, connects to the negative battery terminal via a diode, which passes current in the charging direction only, and a series resistor which has a different value for each battery capacity. This resistor is the current-sense resistor for the constant current regulator inside the radio (or in the AD-14/20 battery charge adaptors).

The essential elements of the current sensing arrangement are shown in Fig.5. When the DC plug is connected, it opens the switched contact S between battery and ground, thereby connecting the sense resistor R inside the battery pack essentially in parallel with the 100 emitter resistor (R7) of the sense transistor Q2, which monitors the current through the pack via the voltage across the R//R7 combination. Provided the drop across the diode D in the battery pack is the same as that across the MA110 diode in the radio, the behaviour of the arrangement is exactly as if the two resistors are in parallel, with a single diode in series. Probably diode D is another MA110, to optimise matching.

The IC-2SRA service manual does not show details of the innards of the battery pack. Indeed Icom in Melbourne was also unable to tell me. But I have deduced from the circuit of the IC-2SAT, which has a 300mAh internal battery, that R = 18 ohms and D is an MA110. From these values I have deduced the value of R for other battery packs, as shown in Table 1. This is information that Icom Australia don't know about their battery packs, so remember that you saw it first here!

Note that all battery packs except the BP-85 are six-cell types. The BP-85 has 10 cells, delivering a nominal 12V for 5W of transmitter output. Except for the BP-86 dry cell case, which differs from the BP-90 only in not having the charging components, the others supply about 7.2V, giving a maximum transmitter output power of about 2W.

I have measured charging currents close to 30mA with the BP-83 and 60mA with the BP-90, which is therefore designed to charge 600mAh NiCad cells in the standard 14 hours. Users of other cell capacities in the BP-90 should adjust the charging time in proportion to capacity.

In Table 1, I show the required 14-hour charging rate of the BP-85 pack, but as far as I know the radio will not charge this 12V pack because of insufficient voltage overhead with a 12.5V (or even 13.8V) DC source applied to the radio. (Note that 10 NiCad cells will rise to about 14V under charge and then the regulator needs a couple of extra volts to work with.) According to the handbook the BP-85 can only be charged with a special plug pack (BC-74), or cable, or with the BC-72 drop-in rapid charger.

I mentioned that battery charging occurs whenever external power is applied to the radio, even when it is turned off.

## Icom's IC-2SRA and related handhelds - 2

This may not be always convenient, but it cannot be circumvented without doing some sort of modification.

The least invasive modification would be to tape over the E- contact on the battery pack. This leaves the current regulator with only the 100-ohm feedback resistor (Fig.5) so it then trickle charges at only a few mA, as shown for the BP-86 battery pack in Table 1. The calculated current shown in the table is 4.6mA and I have measured charging current under these conditions to be 3-4mA, showing that my estimates based on BP-82 charging conditions do not go too far wrong even when extrapolated to this limit.

As mentioned earlier, the switch contacts of the external power socket, which is in the negative side of the supply, are used to set up battery charging conditions. Meanwhile two diodes feed the battery positive and external positive lines to the radio. These protect the radio from reverse polarity supply and prevent a direct connection from the external supply to the battery positive terminal, which would bypass the current regulator.

This arrangement seems utterly foolproof, but the down side is that a forward diode drop is lost in the supply voltage available to the radio. This is of no consequence on external power, where there are generally more volts available than are really needed, but it does cause some loss of performance with 7.2V battery packs.

In earlier series models having external power sockets Icom has used a small relay to avoid such a voltage loss, but clearly the S and W series radios are getting too small for this. Meanwhile, the diodes available are getting better. The SB-20-03P types used are clearly Schottky-barrier diodes. They show a forward voltage drop of only 0.4V at currents up to 1.8A. From Fig.1 I infer that this drop reduces high power output by about 15% at 7.2 volts and reduces overall efficiency from 0.34 to 0.31 (10%), which seems acceptable enough.

In summary I would have to say that a lot of thought and care have gone into the design of these external powering and charging arrangements, which seem to protect the radio and battery packs from most user errors.

One thing that could go wrong is that the switch contacts of the power socket might not operate. I suspect that this was an occasional problem with the older DC coaxial sockets and the new type may be an improvement in this regard — I certainly can't see any other reason for the change.

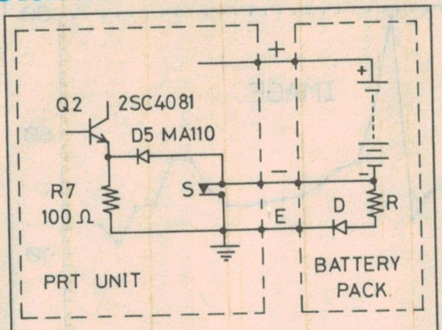



FIG.5 S/W-SERIES CHARGE-CURRENT SENSING

Meanwhile, if this fault did occur it would cause the current regulator to charge at maximum rate. With a BC-74 and a 7.2V battery pack this gives a charge current of about 70mA, which is not too disastrous.

### Rx quality & birdies

One measure of the quality of a receiver is the number of spurious responses that it exhibits. It is by no means trivial to make a wideband receiver with no spurious responses — there are generally always a few frequencies where such a receiver hears mixing products of its own internal frequency generation signals. Some manufacturers of scanners even give a list of the known spurious responses or 'birdies' (as if you could fit any bird inside an IC-2SRA!), which may reduce the number of enquiries from new owners wondering if their radio is faulty.

I have never reviewed or owned a scanner, so I don't really know what is considered to be an acceptable number of birdies. What I do know, is that in one or two US scan magazine reviews of the IC-2SRA the number of birdies is considered to be relatively low. So I decided to count them, to see what qualifies as being 'relatively low'.

To do this I simply chose a mode (NBFM) and step size (25kHz) and set the wideband receiver scanning from 25 to 950MHz, with no antenna connected. Then I wrote down all the frequencies where it stopped scanning.

**Table 1**

| Battery Pack | Height (mm) | Capacity Ah | R (Ω) | Charging Rate (mA) |
|---|---|---|---|---|
| BP-81 | 30.0 | 110 | 68 | 11 |
| BP-82 | 40.0 | 300 | 18 | 30 |
| BP-83 | 59.5 | 600 | 8.2 | 60 |
| BP-84 | 76.0 | 1000 | 4.7 | 100 |
| BP-85 | 76.0 | 340 | NA | 34 |
| BP-86 | 59.5 | Dry cells | | 4.6 |
| BP-90 | 59.5 | 450-700 | 8.2 | 60 |

A page and a half later, I knew that the wideband receiver has 126 birdies between 25 and 950MHz, which at first seems like a lot of blackbirds for just one pie. But it's an average of only 1 every 7.3MHz, which doesn't seem too bad. These are mostly fairly evenly distributed, except in the UHF band where there is not one birdie between 437.375 and 512.00MHz! Could it be a coincidence that this is one of the most interesting pieces of scanning territory in the whole range of the receiver? I don't know...

The above test was done with the squelch at threshold (which, rather impressively, stays the same throughout the whole range of the receiver) which might seem a little demanding. I repeated the test with the squelch set to maximum (i.e., squelch 'tight') and this reduced the number of birdies to 71. So about half of the birdies are fairly weak. Very few seemed to be really strong.

It is possible, of course, to listen to the two-metre receiver local oscillator using the scanner, so that is one extra birdie if the two-metre receiver is on! This is a quick way to monitor the battery saver status, because it allows you to hear the local oscillator switching on and off at the chosen rate.

For a two-metre receiving frequency of 147MHz the local oscillator is at 116.150MHz. Because of the high 266.7MHz first IF of the wideband receiver the two-metre receiver cannot return the compliment, but the 70-cm receiver of the IC-4SRA could!

Of course the number of birdies detected depends on the step size and possibly the mode selected, but 25kHz and NFM seem like reasonable choices. A smaller step size would certainly increase the number. The two-metre receiver had no birdies between 144 and 148MHz, even when scanning in 5kHz steps.

The tests above may seem a little harsh. I can only say that I was never annoyed by birdies when using the wideband receiver. However, I hope that by giving the number of birdies I may encourage other reviewers to do likewise, so that in time the true relativities may become known. After all, it's an easy non-technical test requiring no additional equipment or expertise other than the ability to count past 100. Even the latter will become less demanding, as the technology improves...

Another measure of receiver quality is

adjacent-channel rejection. My observations were that the two-metre receiver had much better adjacent channel rejection than the scanning receiver, although I was unable to devise a measurement that clearly quantifies the difference. Suffice it to say that on narrowband FM, strong signals on adjacent channels do occasionally break through on the wideband receiver, but never on the two-metre receiver.

The probable explanation is as follows. The two-metre receiver is a dual conversion receiver with a relatively high quality crystal filter at the first IF frequency of 30.850MHz, followed by a relatively lower quality ceramic filter at 455kHz which determines the final band width. However the first IF filter probably has comparable bandwidth, so it does not leave all the work to the 455kHz filter.

Meanwhile, the wideband receiver is a triple conversion receiver, with IF frequencies of 266.7MHz, 10.7MHz and 455kHz. The 266.7MHz first filter, which may be a SAW (surface acoustic wave) device does not have to be especially sharp — its main function is image rejection.

In any case it has to be at least wide enough for wideband FM, but I suspect that it would be somewhat broader than that.

The 10.7MHz crystal filter of the second IF is probably of quite good quality, but again it has to be wide enough (e.g., 150kHz) for wideband FM, so on narrowband FM where a final bandwidth of around 15kHz is appropriate a lot of the work is left to the 455kHz ceramic filter of the third IF.

Thus in narrowband FM mode the main difference between the two- metre and wideband receivers is that the crystal filter of the latter is much broader than that of the former. Incidentally, in wideband FM mode a simple L-C filter is used instead of the narrow 455kHz ceramic filter used for AM and narrowband FM modes.

## Audio mixing/output

The IC-2SRA produces mixed audio through a single audio output amplifier, feeding either its internal speaker or an external speaker connected to the 3.5mm stereo speaker-microphone socket on the top panel.

The relative levels of the two receiver outputs are controlled by separate concentric squelch/volume controls on the top panel of the radio. The IC-W2A has a similar arrangement, but allows separate output of one or other of the unmixed outputs through the second 3.5mm socket, in the position used by the wideband receiver antenna socket on the IC-2SRA.

## Conclusion

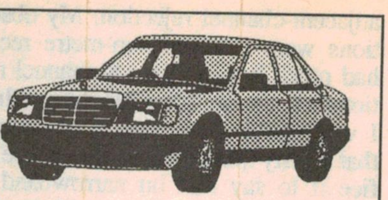
The IC-2SRA is a truly outstanding piece of hand-held technology. It will appeal especially to two-metre enthusiasts who wish to keep an ear on other services, both inside and outside the amateur bands. WICEN operators may find this facility particularly useful, but any two-metre operator could easily get hooked on scanning the aircraft, VHF-marine and commercial UHF bands.

The IC-2SRA comes with the normal accessories: two antennas, belt clip, wrist strap, battery charger and, of course the 300mAh BP-82 battery pack.

As mentioned earlier, it comes with a very comprehensive instruction manual, but no circuit diagram — which is the first time I have seen Icom do this. The reason is probably that the circuits fill several A3 size sheets. To get them you need to buy the Service Manual, which is also very comprehensive, and costs about $50.

Our thanks go to Icom Australia for the loan of the review unit, which was serial No 01757. ❖

# AUTOMOTIVE ELECTRONICS



with MAJOR AL YOUNGER (USAR, Ret.)

## The Electronic Transmission - 2

**Last month we looked at lock-up transmissions, and how the transmission received the information needed for its operation. This time we look at the electronically controlled transmission or 'ECT', how it works and the problems encountered in its operation. Even more information is required by the ECT for its operation, while the engine management ECU or 'ECM' also requires information from the transmission — because the transmission is still essentially a slave to the engine.**

The transmissions in use today will never achieve the theoretical 'perfect shift'. The shift point can be spot on, but ideally the time it takes to shift would have to be zero. To make a shift one gear must be released, whilst another is applied. This time is shown in Fig.1, showing the 'shift pattern'; the start of one gear being released is A, the next gear fully applied is B. The closer A is to B the more efficient the shift.

At present research is being done on *continuously variable* transmissions, which will approach the perfect shift. So the problem is a mechanical one, not one of shortcomings in electronic control.

It's important to remember that *electronic control* means just that. The electronics is only used for controlling transmission; all of the action in the transmission is done hydraulically (See Fig.2, showing a solenoid valve). Think of it this way: the ECU computes what is to be done; it sends control signals (power or earth) to the solenoids, which open or close a hydraulic path; this then allows hydraulic pressure to do the work (gear selection, shifting, etc). The solenoid valve acts as a hydraulic switch controlling the flow path of the oil.

By the way, we're going to be talking here about four-speed or overdrive ECT transmissions. (Overdrive means that the differential 'rear-end' rotates at a higher speed than the engine.) Another way to obtain fuel economy is to increase the differential ratio, giving less engine RPM in top gear and less fuel consumption. And most use torque converter lock-up or apply a direct drive shaft. The name of the game as far as fuel economy is concerned is direct drive 'ASAP' — as soon as possible.

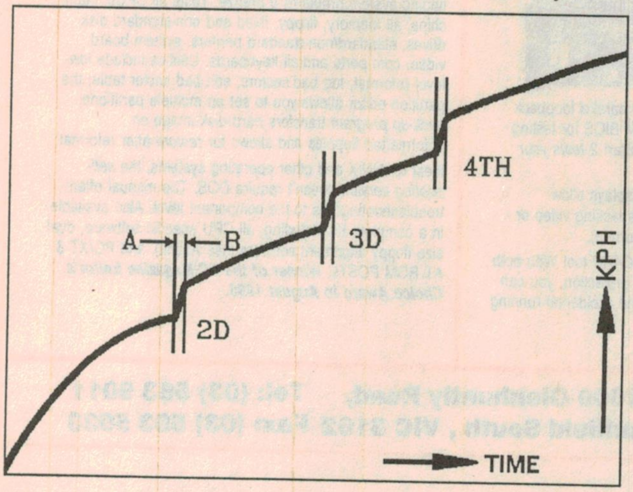



*Fig.1: The time/kph 'shift pattern' for a typical four-speed automatic transmission, showing how it takes a finite time to release one gear (point A) and apply the next one (B).*

### ECT infancy

The first attempts were to take an automatic four-speed that hydraulically shifted to top gear, and add electronic control. They even took three-speeds and bolted on gears to make them into a four-speed. Along the way a lock-up clutch was added. Then the electronics were added, controlling things by monitoring and then inhibiting or 'disallowing' various functions. After all, they were converting hydraulic units to electronic control. Let's call this what it is, a conversion.

Consider a four-speed automatic with lock-up that was converted to electronic control. It worked fine under hydraulic control, so why was it converted? Well for one thing, electronic control is much faster than hydraulic. And now we need information from the transmission to the ECM; a data bus, if you like. As mentioned before the status of the transmission is important to the overall electronic management operation.

These first 'converted' units had their own ECU's, and still required the same inputs and outputs. The ECU-controlled functions of the transmission are 'lock-up' and '4th-gear apply'. This was accomplished by adding two 'inhibiting' solenoids; one solenoid for lock-up, the other for 4th-gear apply.

(Yes, there is a simpler system. It is just a temperature switch, which inhibits lock-up and 4th-gear until engine temperature is adequate. It sends no data to the ECM as to its status. But it's cheap, because there's no need for an ECU. This is the kind of system that will soon be 'outlawed', with new emission and pollution standards.)

The last evolution in conversion found Detroit adding shift solenoids to the valve bodies. But they were still essentially conversions, not designed as electronic transmissions from scratch.

### ECT overview

The lock-up type transmission only requires a few inputs, in comparison to an electronic transmission (Fig.3, ECT). Here we will talk about a true electronic transmission, one that came right off the drawing board. With its own ECU and a data link to the ECM, it knows everything except the sex of the driver.

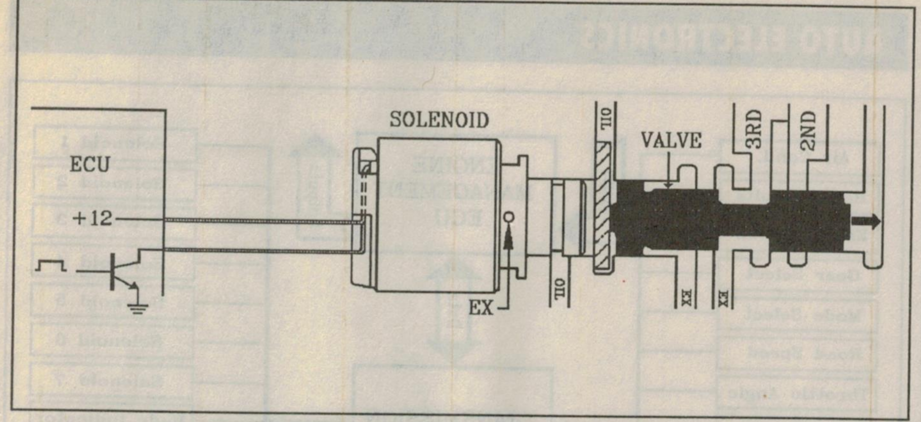



*Fig.2: Transmission control is achieved by the ECU switching current to a solenoid valve, shown here. The valve then controls oil under pressure, so that hydraulic power performs the 'real work' of gear selection and shifting, etc.*

The perfect automatic transmission shifts at a precise point on the engine's torque curve. Perhaps only a professional race driver or a transmission engineer could fully appreciate that statement. The electronic transmission has its own dedicated computer (let's call it the ECU — Electronic Control Unit) and some also have dedicated outboard devices (sensors) for their own use. They also have a *bidirectional* data link to the main ECM, passing data in both directions. The valve body is 'loaded' with solenoids, for shifting and controlling the transmission.

In the electronic transmission the ECU controls the shift schedule (when the gear shifts occur); the quality of the shift ('firmness') and the line pressure. The heart of the system is the ECU, complete with a PROM. Like any other computer the PROM firmware (program) runs the whole show.

## How does it work?

It would take all of the pages in this magazine for a complete and detailed explanation of ECT operation. But with a little input, you can figure it out. You all know the capabilities of a microprocessor, like the one in your PC. It just needs good information (input from sensors), a program (PROM) and a data base (ROM look-up tables).

In this case, what we are trying to accomplish is to shift the transmission from one gear to the next at precise points on the engine's torque curve, and then finally into direct drive. It takes a professional human driver to come close to this, the transmission ECU does a reasonably good imitation for us. Knowing this, and with our electronic background, we can figure out what is transpiring — at least in general terms.

Basically the ECU monitors all sensors and indirectly computes the torque curve. When all conditions are satisfied, the ECU sends control signals (via either the battery '+' or earth path) to the shift and pressure control solenoids, to effect each gear shift. That's really it, but it's not over yet. The transmission plays a vital role in engine management and emission/pollution control.

When the transmission is in cruise (top gear), it informs the engine ECU. The engine ECU then activates emission controls (like charcoal canister purge) and sets the final timing for best fuel consumption and the least exhaust pollution. That's the remaining function, and one that's very important.

## ECT problems

The ECU must have precise data to control the transmission. Any engine or sensor fault will effect the operation of the transmission, emission and pollution controls. So we are right back to basics. The engine must be in good nick and all systems working correctly.

Don't forget that an electronically controlled car will tell you when it needs help. However, do not expect it to throw you a code or 'light the dash' (CEL or 'check engine lamp' on). Most often, the actions of the vehicle will let you know that it is in need of help.

Any change in operation is the first sign. Things like the engine becoming significantly harder to start; developing a noticeable hesitation in response to the accelerator; the idling becoming erratic; changes to the transmission shift pattern; harsh engagement; stalling when stopping; the engine continuing to run with ignition OFF — and when things are in a bad shape, backfiring through the intake or exhaust.

Any change in operation or performance should be looked into immediately. It has been said so many times that it is now a cliche, but also a truism: pay me now, or pay me more later. Just like any man-made device, electronic or whatever — ignoring it will not make it go away, it will just get worse and cost more to fix.

I read somewhere that the automotive transmission processor was not as powerful as a PC. You be the judge. Let's pick one up and see what it has in it. Here's just the big stuff:

- Processor (Intel 16-bit)
- Crystal Oscillator (10MHz)
- Quad op-amp chip
- Hex Inverter chip
- EPROM chip (16K)
- RAM chip with capacitor back-up

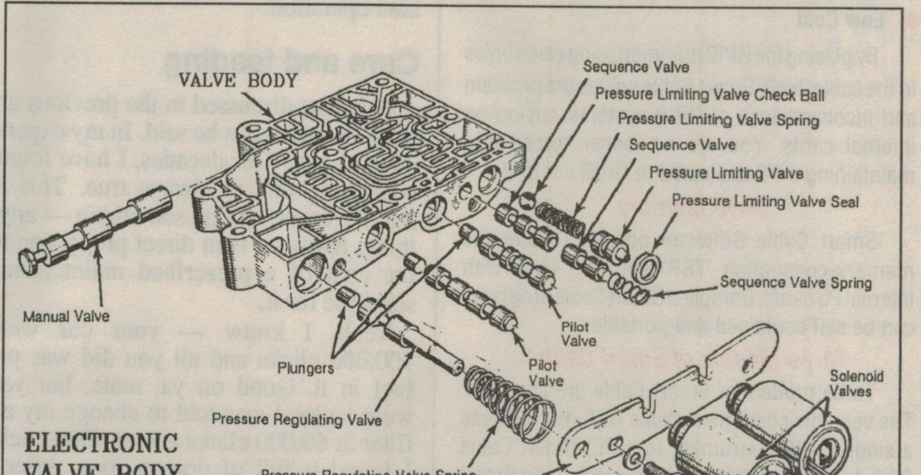



*Fig.3: Inside the 'electronic valve body assembly' of an electronically controlled four-speed auto transmission. The ECU controls the solenoids at lower right, and these in turn control the hydraulics via the pilot valves.*

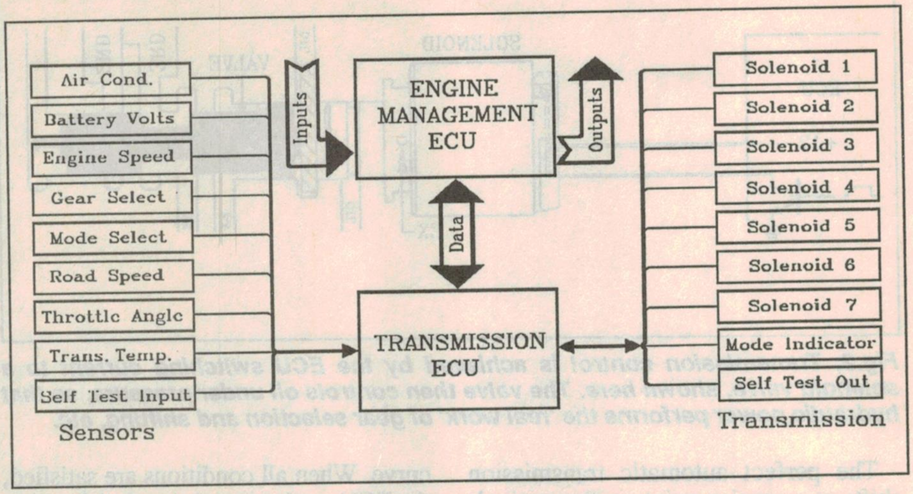



***Fig.4: The transmission ECU has its own sensor inputs and control outputs, as well as a data link to the engine ECM.***

Transistor solenoid drivers (7)
Data link chip (link to ECM)
Voltage regulator (TO-220 5V)

This is a small one. You should see what's in some trucks, just for the transmission ECU.

## Self diagnostics

The electronic controlled transmission's ECU provides access to diagnostic codes to aid in troubleshooting, should a fault occur. Some provide a diagnostic link that allows monitoring of the sensors and other ECT data, in real time. The codes may be read from the instrument panel CEL, or a separate indicator lamp especially for the transmission operation.

## Care and feeding

This was discussed in the previous article, but more can be said. In my experience of over four decades, I have found something that is always true. This is that the cost of fixing something — anything, really — is in direct proportion to the cost of a prescribed maintenance schedule for it.

Yeah, I know — your car went 100,000 clicks and all you did was put fuel in it. Good on ya, mate, but you were lucky. I was told to change my air filter at 60,000 clicks and at 5000 clicks I found it full of dragon flies. After I changed it I got much better fuel consumption and performance.

I belonged to what was perhaps the largest automotive trade organisation in the world, covering all of North America. A group of us got together and discussed vehicle scheduled maintenance. Here are a few things we felt were truisms, despite their familiarity:

'Pay me now or pay me later'. (You will pay more later.)

'If it ain't broke, don't FIX it'. (Quotation by Alfred E. Neuman, the idiot in *Mad* magazine)

'My brakes are so bad, I drive slower'. (*Mad Max I, II* and *III*)

Famous last words: 'But it was just a small leak...'

'People take better care of their horse'. (But they shoot horses)

Excerpt from a car owner's manual: '...under normal driving conditions...' (Definition: You drive to Paddy's Market every Saturday, from your home in Surry Hills.)

In short, the best preventive maintenance is achieved by using good old *commonsense*. Take care of your car on a routine basis, and save money and inconveniences. Ask the bloke in South Australia who has 1,000,000 clicks on his Mercedes. Or a friend of mine that has 1,600,000 clicks on a 1948 Buick. Good on ya, mates. Keep it up!

Before we end, just a little information about an exciting transmission built here. BTR, an Aussie company, has a true electronic transmission designed and built here. At present it is available in the Ford line. It is one of the best examples of a true electronic transmission. It is strong and shifts superbly.

For those that are interested in transmission ECU diagnostic codes, my *Code Book* for all engines and transmissions is still available. Send $35.00 to: Major Al, PO Box 477, Double Bay 2028. *Maintaining the Electronic Motor Car* is also still available for only $25.00. ❖

# 5.25" from 39¢ CHEAP BULK DISK PRICES! 3.5" from 62¢


## NO BRAND DISKS

ALL DISKS INCLUDE WRITE PROTECTS & ENVELOPES
BOXES OF TEN DISKS LIFETIME WARRANTY

| | 1-9+ | 10+ | 50+ | 100+ | 500+ |
|---|---|---|---|---|---|
| 5 1/4" DS/DD | $4.75 | $4.60 | $4.40 | $4.20 | $3.95 |
| 5 1/4" DS/HD | $8.50 | $8.25 | $8.10 | $7.95 | $7.50 |
| 3 1/2" DS/DD | $8.50 | $8.25 | $8.10 | $7.95 | $7.50 |
| 3 1/2" DS/HD | $13.95 | $13.50 | $12.50 | $11.95 | $10.95 |

## MEMOREX DISKS

| | 1-9 boxes | 10+ |
|---|---|---|
| 3 1/2"DD | $19.95 | $18.95 |
| 3 1/2"HD | $45.95 | $42.95 |
| 5 1/4"DD | $14.95 | $12.95 |
| 5 1/4"HD | $23.95 | $22.95 |

## VERBATIM DATALIFE

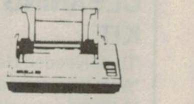
| | 1-9 boxes | 10+ |
|---|---|---|
| 3 1/2"DD | $21.95 | $20.95 |
| 3 1/2"HD | $42.95 | $41.00 |
| 5 1/4"DD | $17.95 | $16.95 |
| 5 1/4"HD | $22.95 | $21.95 |

## VERBATIM VALUELIFE

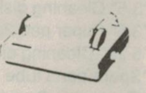
| | 1-9 boxes | 10+ |
|---|---|---|
| 3 1/2"DD | $19.95 | $18.95 |
| 3 1/2"HD | $34.95 | $32.95 |
| 5 1/4"DD | $10.95 | $9.95 |
| 5 1/4"HD | $15.95 | $14.95 |

YOU'LL HAVE TO GO A LONG WAY TO FIND DISK PRICES LIKE THESE

# SAVE ON OUR GREAT RANGE OF EPSON PRINTER

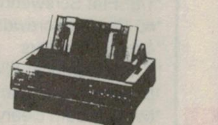


**LX-400** 80 Col, 9 Pin Dot Matrix, 180 Cps Draft 30 Cps NLQ, Pull Tractor
C22054................ $245

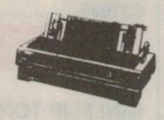


**LX-850** 80 Col, 9 Pin Dot Matrix, 240 Cps Draft 48 Cps NLQ, Push Tractor, Smart Park Feature
C22074.................. $375

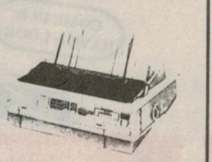
**LQ-100** 80 Col, 24 Pin Dot Matrix 200 Cps Draft, 72 LQ, Built in sheet, feeder 8 fonts. 2 scalable fonts
C22070.............................. $399



**LQ-870** 80 Col, 24 Pin Dot Matrix, 330 Cps Draft, 110 Cps NLQ, Scalable Fonts, 8 to 32 points, 11LQ Fonts, 360 x 360 DPI, Top, Rear, Bottom, & Front paper Feed paths Convertable Push/Pull Tractor.
C22072...................... $950



**LQ-1070** 136 Col, 24 Pin Dot Matrix, 252 Cps Draft., 84 Cps NLQ, Scalable Fonts, 8 to 32 point, 11 LQ Fonts, 360 x 360 DPI, Top, Rear, Bottom, and Front Paper Feedpaths, Convertable Push/Pull Tractor
C22066.......................... $770



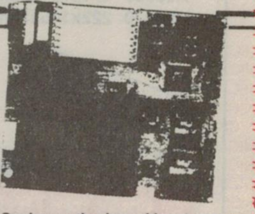
**LQ-570** 80 Col, 24 Pin Dot Matrix, 252 Cps Draft, 84 Cps, NLQ Scalable Fonts 8 to 32 points, 11 LQ Fonts 360 x 360 DPI, Top, Rear, Bottom and Front paper feed paths, Convertable Push/Pull Tractor.
C22068................. $549

**LX-100** 80 Col, 9 pin Dot Matrix, 240cps Draft, 48 cps NLQ, 3 fonts, 50 sheet paper cassette Standard Push Tractor with SmartPark.
..............................$399

## EPSON LASER EPL-4000

Combines a semiconductor laser with electrophotographic technology to give you high quality printing that is both fast and quiet. The EPL-4000 can compose an entire page in its internal memory before printing. It has the ability to mix text graphics, create pre defined forms and print with a range of fonts normally associated with typesetters............$1495.00

## 386/486 MULTIBOARD WITH 386-40 PROCESSOR FITTED



The OPTI-495SX 3/486WB Cache motherboard is a low cost 3 chip solution offering optimal performance for low to Mid range 386/486 Cache base AT sysytem. The OPTI-495SX 3/486WB Cache M/B is designed for 386 systems running from 25 33 and 50MHz It supports 386DX, 486SX, 486DX 486DX2 and one 32 Bit local Bus.
The OPTI-495SX 3/486WB Cache motherboard also has an option to accomodate either 64K, 128K, 256K, of external Cache and support the 80387 numerical Co-processor. Because of it's unique memory subeystem design, the OPTI-495SX 3/486WB Cache M/B allows for 1 Megabyte to 32 Megabytes of 32-bit high speed memory by using 256K, 1M amd 4M SIMM modules.
Cat No.
X18117...................................$499.00
Rod Irving Electronics now provides a motherboard that works around the pinout problems with jumpers that allow you to start off with a bare motherboard and install whatever CPU you wish to use (386 or 486). So therfore just by changing your CPU at a later date you can upgrade your system.

## Local Bus VESA 1 MEG VGA card to suit above multiboard....$499.00

## IBM CARDS

| | |
|---|---|
| NEW LOCAL BUS VESA CARD for HIGH SPEED GRAPHICS | $499 |
| PRINTER CARD | $29 |
| 6M RAM CARD | $249 |
| 2 PORT SERIAL CARD | $39 |
| GAMES CARD | $29 |
| CLOCK CARD | $39 |
| 512/576K RAM CARD OK RAM | $69 |
| 2 WAY FDD CONT. | $89 |
| 4 WAY FDD CONT. | $129 |
| VGA 16 BIT 256K | $59 |
| VGA 16 BIT 512K | $79 |
| VGA 16 BIT 1 MEG | $149 |
| 16M HD CACHE CARD OK RAM | $495 |
| HDD IDE /FDD 24MHz | $29 |
| HDD IDE/FDD/SPG | $39 |
| 8 BIT ETHERNET CARD | $235 |
| 16 BIT ETHERNET CARD | $285 |
| AT HD CONTROLLER | $149 |
| MULTI I/O CARD | $99 |
| MONO COLOUR CARD | $69 |
| EGA CARD | $99 |
| DIAGNOSTIC CARD | $795 |
| TTL PRINTER CARD | $79 |
| FAX CARD | $595 |
| 6M AT EX/EXP. | $225 |
| PARADISE ACCELERATOR | $275 |
| PARKEET ACCELERATOR | $269 |

## HARD DRIVE SPECIALS

PRICES ARE WITHOUT PADDLE CARDS & BRACKETS
*2 YEAR WARRANTY ON VOICE COILS*

| | |
|---|---|
| 40M SEAGATE DRIVE | $299 |
| 85M HD 6ms T.T ACCESS. VOICE COIL | $369 |
| 105M HD 6ms T.T ACCESS | $419 |
| 126M HD 6ms T.T ACCESS. VOICE COIL | $449 |
| 170M 6ms T.T ACCESS | $539 |
| 212M HD 5ms T.T ACCESS. VOICE COIL | $599 |
| 345M H.D 5ms T.T ACCESS | $995 |
| 424M H.D 5ms | $1495 |
| 528M HD 5ms T.T ACCESS | $2295 |

## MEMORY

| MEMORY | 1-9 | 10-99 | 100 + | |
|---|---|---|---|---|
| 41256-08 | $2.95 | $2.75 | $2.50 | |
| 44256-07 | $7.95 | $7.50 | $6.50 | |
| **SIMMS** | **1-9** | **10-24** | **25+** | **100+** |
| 256K-60 | $29 | $27 | $26 | $25 |
| 256K-70 | $23 | $21 | $19 | $17 |
| 256K-80 | $21 | $19 | $17 | $15 |
| 1M x 9-70 | $59 | $57 | $55 | $54 |
| 1M x 9-60 | $62 | $60 | $59 | $57 |
| 4M x 9-70 | $235 | $229 | $249 | $219 |
| 4M x 9-60 | $369 | $359 | $349 | $3290 |

72 PIN RAM MODULES 4 MEG RAM...$349.00
8 MEG RAM....$649.00
16 MEG RAM....$1,279.00

## MOTHERBOARDS

| | |
|---|---|
| 386SX-33/41 | $199.00 |
| 386-33 64K CACHE | $399.00 |
| 386-40 128K CACHE | $369.00 |
| 486SX-33 256K Cache | $695.00 |
| 386-40 128 Cache with Upgradable CPU socket | $499.00 |
| 486-33 256K CACHE | $995.00 |
| 486-33 256K CACHE 3 Local Bus Slots | $1395.00 |
| 486-50 256K CACHE | $1395.00 |
| 486-66 256K CACHE | $1595.00 |
| 486-33 EISA | $2495.00 |
| 486-50 EISA | $2645.00 |

*WHO HAS THE LATEST TECHNOLOGY?.....WE DO!*

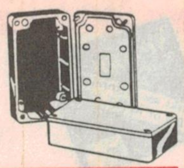
## MONITOR SPECIALS

SUPA VGA COLOUR MONITOR "3 YEAR WARRANTY"
This stylish and reliable monitor has been designed for Australian conditions & comes with a 3 year warranty.
SPECS: cte: 14" 90° deflection, dark tint, non-glare.
Display size: 245+/5mm x 180+/-5mm x 180+/-5mm
Resolution: (max): 1024 x 768.
only $429.00


SUPER VGA *NEW* MULTISCAN COLOUR MONITOR 0.28" D.P NON-INTERLACED 1024 x 768...$549.00

# WHO HAS DIE CAST CASES? WE DO!

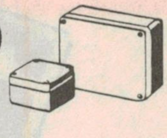
WITH BUILT IN GASKET FOR TOTAL WEATHER PROOFING



## NEW DIECAST BOXES

| | | 1-9 | 10+ |
|---|---|---|---|
| H30000 | 90x36x30mm | $6.75 | $5.95 |
| H30010 | 64x58x35mm | $6.95 | $6.25 |
| H30020 | 115x65x30mm | $10.95 | $9.50 |
| H30030 | 115x65x55mm | $12.95 | $11.50 |
| H30040 | 115x90x55mm | $15.95 | $14.50 |
| H30050 | 148x108x75mm | $27.50 | $24.50 |
| H30060 | 171x121x55mm | $27.95 | $24.95 |
| H30070 | 222x146x55mm | $29.95 | $27.95 |

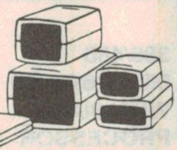
GREAT VALUE! COMES WITH BUILT IN RUBBER GASKET AND WEATHER PROOFING.



## NEW SEALED POLYCARBONATE ENCLOSURES

| | | 1-9 | 10+ |
|---|---|---|---|
| H30200 | 64x58x35mm | $4.95 | $4.50 |
| H30210 | 115x65x40mm | $6.95 | $5.95 |
| H30220 | 115x65x55mm | $8.95 | $7.95 |
| H30230 | 115x90x55mm | $11.95 | $9.95 |
| H30240 | 117x121x55mm | $19.95 | $17.95 |
| H30250 | 222x146x55mm | $24.95 | $22.95 |

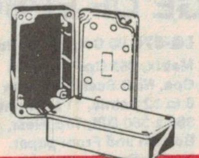
ONLY A 1/4 OF THE PRICE OF EUROPEAN ONES



## NEW INSTRUMENT CASES

| | | 1-9 | 10+ |
|---|---|---|---|
| H30300 | 90x15x16mm | $4.95 | $4.50 |
| H30305 | 90x50x24mm | $5.95 | $4.95 |
| H30310 | 90x50x32mm | $6.50 | $5.50 |
| H30315 | 120x60x30mm | $6.95 | $5.95 |
| H30320 | 120x60x40mm | $7.50 | $6.25 |
| H30325 | 120x60x50mm | $7.95 | $6.50 |
| H30330 | 150x80x30mm | $8.95 | $7.50 |
| H30335 | 150x80x45mm | $9.95 | $8.50 |
| H30340 | 150x80x60mm | $11.95 | $9.95 |
| H30345 | 190x100x40mm | $12.95 | $10.95 |
| H30350 | 190x100x60mm | $14.95 | $12.95 |
| H30355 | 190x100x80mm | $16.95 | $14.95 |

COME IN & HAVE A LOOK!



## NEW WATERPROOF CLEAR TOP POLYCARBONATE INSTRUMENT BOXES

| | | 1-9 | 10+ |
|---|---|---|---|
| H30100 | 64x58x35mm | $8.95 | $7.95 |
| H30110 | 115x65x40mm | $11.95 | $9.95 |
| H30120 | 115x65x55mm | $12.95 | $10.95 |
| H30130 | 115x90x55mm | $14.95 | $12.95 |
| H30140 | 171x121x55mm | $20.95 | $18.95 |
| H30150 | 222x146x55mm | $24.95 | $21.95 |

## CHECK OUT OUR LARGE RANGE OF LEDS

### RECTANGLE LEDS

5MM x 2MM

Z10160 Red

| 1-9 | 10+ | 100+ |
|---|---|---|
| $0.25 | $0.20 | $0.15 |

Z10162 Green
Z10164 Yellow

| 1-9 | 10+ | 100+ |
|---|---|---|
| $0.30 | $0.25 | $0.20 |

Z10166 Orange

| 1-9 | 10+ | 100+ |
|---|---|---|
| $0.30 | $0.25 | $0.20 |

### 5mm RED/GREEN DUAL LED

Z10158..........................$1.50

### BLUE LEDS

Good quailty, bright blue LEDs with a 30° veiwing angle. Comes in two sizes: 3mm dia & 5mm dia. Panel mounting clips are available separatly The 3mm & 5mm are both water clear (transparent) in appearance but light up a beautiful blue colour.

| | Min | Standard |
|---|---|---|
| Case Size (dia) | 3mm | 5mm |
| Light output typical at 1F=20mA | 14mcd | 14mcd |
| Forward Volage at 1F=20mA | 3.0V | 3.0V |
| Forward Current Max | 50mA | 50mA |
| Reverse Voltage Max. | 5V | 5V |
| Power Disipation | 100mW | 100mW |
| Peak Wavelength | 470nm | 470nm |

| | MDC | 1-9 | 10-99 | |
|---|---|---|---|---|
| Z10152 | 14 | $3.75 | $3.50 | 3mm |
| Z10153 | 14 | $3.75 | $3.50 | 5mm |

### 3mm LEDS

Z10140 Red

| 1-9 | 10+ | 100+ |
|---|---|---|
| $0.20 | $0.15 | $0.12 |

Z10141 Green
Z10150 Yellow
Z10154 Orange

| 1-9 | 10+ | 100+ |
|---|---|---|
| $0.30 | $0.25 | $0.20 |

### 5mm LEDS

Z10150 Red

| 1-9 | 10+ | 100+ |
|---|---|---|
| $0.20 | $0.15 | $0.10 |

Z10151 Green
Z10152 Yellow
Z10154 Orange

| 1-9 | 10+ | 100+ |
|---|---|---|
| $0.30 | $0.25 | $0.15 |

### 10mm JUMBO LEDS

Z10155 Red
Z10156 Green
Z10157 Yellow

| 1-9 | 10+ | 100+ |
|---|---|---|
| $0.95 | $0.90 | $0.80 |

### 12 SEGMENT RED DISPLAY

Z10183 $8.50

### SUPA BRIGHT LEDS

Z10146 Red
Z10147 Green
Z10148 Yellow

| 1-9 | 10+ |
|---|---|
| $1.00 | $0.90 |

### 5mm FLASHING LEDS

Z10159 Red

| 1-9 | 10+ |
|---|---|
| $1.10 | $1.00 |

### 1/2" HIGH INTENSITY RED LED DISPLAYS

Available in common cathode and common anode

| | 1-9 | 10+ |
|---|---|---|
| Z10190 | $2.75 | $2.50 |

### HIGH INTENSITY RED LED BAR GRAPH

| | 1-9 | 10+ |
|---|---|---|
| Z10180 | $4.95 | $4.50 |

### 10 SEGMENT DISPLAY

| 1-9 | 10+ |
|---|---|
| $8.50 | $7.50 |

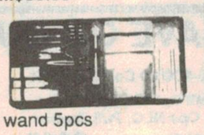
### MULTICOLOUR ARRAY

| | 1-9 | 10+ |
|---|---|---|
| Z10184 | $8.95 | $7.95 |

## COMPUTER TOOL KIT

*2 Nutdriver: 3/16", 1/4"
*1-Three Claw Parts Retriever
*1-Assembly Tweezer
*1-Phillips Screwdriver, #0
*1-Slotted Screwdriver, 1/8"
*1-Integrated Circuit Extractor
*2-Screwdriver Bits Holder
*1-Poundle Way Bits, Torque: T10, T15
*1-Poundle Way Bits, Phillips: #1, Slotted: 3/16"
*1-Extra Parts Tube
*1-Zipper Vinyl Case
T12451..............................$39.95

## COMPUTER CLEANING KIT



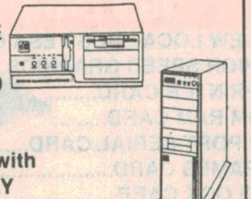
*Dual-Needed cleaning wand 5pcs
*Antistatic computer cleaning cloth
*Antistatic cleaning pad 6pcs
*3.5" Cleaning disk
*3.5" Paper pad 2pcs
*5.25" Cleaning disk
*Spare parts tube
*Reversible Screwdriver Bit. 3/16" & #1 1/4" #2
*ReversibleBit. T10/T15
*Reversible Bit. Nut Driver.#/16", 1/4"
*Reversible Handle
*1/8" Flat Screwedriver
*#0 Phillips Screwdriver
*4-3/4" Tweezers
*4-1/2" Diagonal Pliers
*5" Long Nose Pliers
*Mini vacuum cleaner
*Head cleaning Fluid 18C.C.
*Cleaning Solution 60C.C.
*Black Vinyl zipper case
C21086..................................$59.95

EVERY COMPUTER OWNER SHOULD HAVE ONE OF THESE!

## CASES

Case styles will vary from illustrations

MINI FLIP TOP TOWER CASE with POWER SUPPY..$105.00



FLIP TOP CASE with POWER SUPPLY..$95.00

TOWER CASE with POWER SUPPLY $250.00

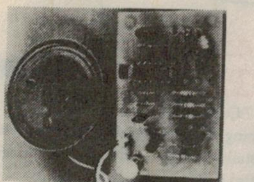
## ETHERNET CABLES

Made up and ready to use with connectors
2M 50ohm cable ..............$9.95
3M 50ohm cable ..............$11.95
5M 50ohm cable ..............$14.95
10M 50ohm cable.............$24.95
20M 50ohm cable.............$39.95

## BOX HILL STORE NOW OPEN

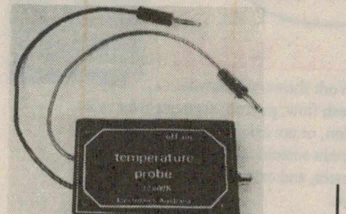
*1031 MAROONDAH HWY RINGWOOD (opposite BoxHill town hall)*
*Ph: (03) 899 6033 FAX: (03) 899 0156*

# MORE KITS FROM ROD IRVING ELECTRONICS



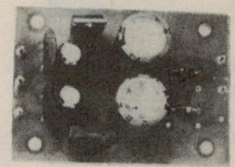
## 2 TONE ALARM MODULE

If your looking for an ear catching alarm that produces a melodic 2 tone sound that packs quite a punchfor its size, then this is the module for you. It is designedfor those times you need an "easy on the ears" sound. It's a great alarm
for things such as a water level monitor,or automotive gauge monitor. This module uses eay to get parts and can be built in a couple of hours.
Sil Chip Jan 1991.
K10095..............................$9.95




## TEMPERATURE PROBE

An easy to build probe design which adapts a multimeter or an electronic voltmeter into a general purpose thermometer. It uses easy to get components and is also suitable for building into other projectswhere they require temperaturesensing.It's ideal for measuring heatsink temperatures, how hot it gets inside your car or even checking the temperature in the wine cellar.
K10215..........................$19.95



## UNIVERSAL POWER SUPPLY
### Low Cost Circuit give +15V, -15V or ±15V

This small board enables you to obtain +15V, -15V or ±15V DC from a number of different transformer and rectifier combinations. It's one PCB pattern you can use in four different ways to obtain 15V.
Silicon Chip Aug 1988
K10125.................................$12.95

## KNIGHTRIDER LED SCANNER

This little kit is a lot of fun.
If you have ever seen the television show "Knightrider" you will probably remember the front of the computerised car which has a row of red lights moving back and forth supposedly scanning the area. Well now you can simply make a row of 20 light emmiting diodes which scan back and forth. Place it on the kids bike or skateboard or on the front of a radio controlled car. It uses cheap and readily available ICs, a 555 timer and a 4017 decade counter. You could even use it as visual deterrent to thieves by placing it on a burglar alram. Sil Chip Nov '88
K10135......................................$17.95

## WELLER SOLDERING STATION

With Temperature controlled soldering iron .
A transformer powered soldering station complete with low voltage temperature controlled soldering pencil. The soldering pencil features a stainless steel heater construction, a non burning silicon rubber cord and a large selection of iron plated tips
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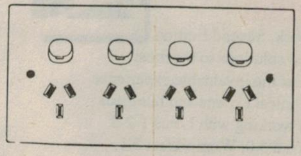

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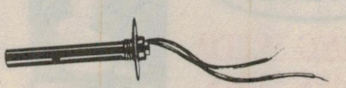

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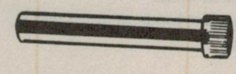

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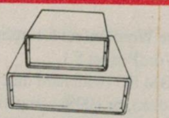

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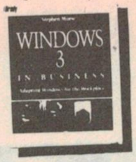


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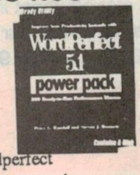


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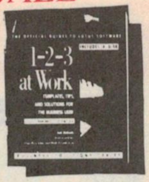


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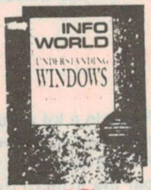


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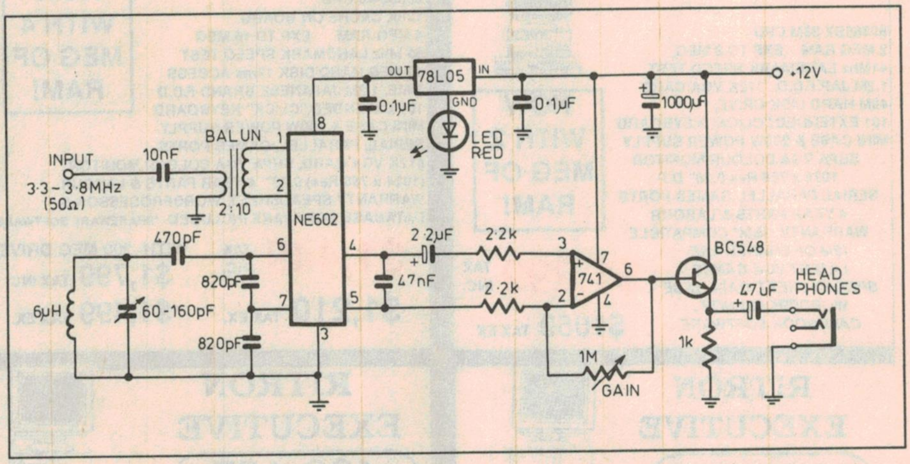
# Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

## Direct conversion receiver




A direct conversion receiver works by mixing the input signal with a signal from a local oscillator of almost exactly the same frequency.

The audio beat frequency output then needs only to be amplified to drive headphones or a speaker. This type of receiver will pick up SSB and Morse code. As described, the circuit is for the 80m amateur band.

In this design, the mixer and oscillator are combined on a NE602 integrated circuit. The 50-ohm input is stepped up to match the IC input by a transformer (2 turns primary, 10 turns secondary on a balun core).

No input filter is described because the mixer is double balanced, and so rejects even harmonics. However, strong odd harmonics or other interference would require a single or double tuned circuit across the inputs to the IC.

The local oscillator is a Colpitts circuit, tuning from about 3.3 to 3.8MHz. Pins 6 and 7 of the NE602 are simply connections to the base and emitter of an internally biased transistor.

For this reason, almost any discrete tank or crystal oscillator circuit, minus the biasing components, can be used here. The NE602 works to hundreds of megahertz, so it is only necessary to change these components to receive VHF signals.

The IC produces a balanced output from pins 4 and 5, which is amplified by a differential audio amplifier (741 opamp), which provides a voltage gain of up to 500. This is followed by an emitter follower to drive 32-ohm headphones to an ample volume.

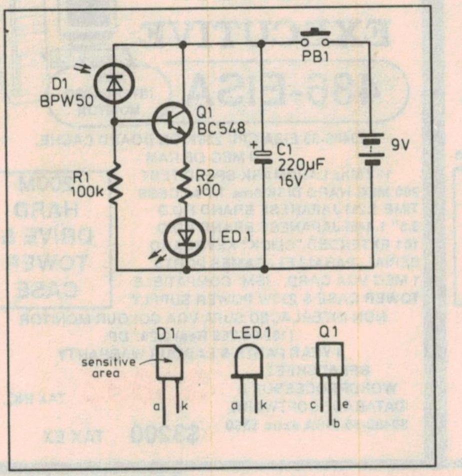
Direct conversion receivers need very high audio gain, as there is no intermediate frequency. The only other gain in this circuit is the 18dB or so provided by the NE602. The 47nF capacitor across the IC outputs acts as a low pass filter, and the 1M pot as a gain or volume control.

Keep the leads in the audio amplifier as short as possible, including those to the gain control, to prevent oscillation.

The 78L05 and red LED provide a supply of about 7V, which is below the NE602's maximum of 8V, and ensures that pins 4 and 5 are biased to approximately half of the supply voltage. The power supply to the circuit should be from 9 to 15V, and must be well filtered because of the high audio gain.

Jeffrey Harrison,
Mount Waverley, Vic **$45**

## Remote control tester




As a TV serviceman, I often encounter infrared remote control units that refuse to 'talk' to their intended TV, VCR or hifi. Unfortunately, most customers only bring the remote control unit to me, assuming that the fault lies in it rather than in the equipments it controls (which is usually the case).

What they don't realise is that it is difficult to know whether the remote is working (after attempting a repair) without having the TV, etc. at hand to indicate a response.

To get around this problem, I use this simple circuit to see if an IR remote control unit is emitting any signal. Using new parts, it would cost about $13 to build, including battery and case, and the construction doesn't even require a PCB.

IR diode D1 is normally reverse biased via resistor R1, but conducts when it senses an infrared signal, pulling the base of transistor Q1 high. This causes Q1 to conduct, feeding current through R2 in series with LED1. The LED lights in response to the detected IR signal. Since the signals from remote control units are a series of pulses, capacitor C1 helps maintain current to LED1 during each pulse. Due to the intermittent use of such a circuit, a 9V battery provides a suitable power supply, activated via momentary pushbutton PB1.

Note that normal IR receiver circuits use a filter/preamplifier and are sensitive over about 10m.

Here, however, the range is limited to only a few centimetres, over which LED1 will show good brightness. However, this range is perfectly adequate because of the portable nature of the tester — just hold it up to the emitting LED(s) of the remote and check LED1 for any response.

I built my unit in a UB5 (28 x 54 x 83mm) zippy box, and fitted insulated sleeving to all bare component leads.

Make sure that the correct side of the IR diode is facing out of the case, and place packing around the battery to stop it moving about.

Tim Gregory,
Alberton West, Vic **$40**

## Fuzz and wah-wah pedal

My 17 year old son is an aspiring guitarist, but unable to afford the high priced quitar effects units from the usual retail outlets. In particular he wanted an effect called 'wah-wah', which consists of sweeping a bandpass filter across the audio range.

A 'fuzz' circuit was also considered desirable. I made the decision to adapt a cheap sewing machine control pedal, when I found that I could buy a new one for only %25. The unit purchased was a 'Wernard Foot Control FC1'.

It turned out to contain a six-step shorting bar, progressively reducing the series resistance of the unit (in about 100 ohm steps, from 500 ohms to zero), presumably for controlling the sewing machine motor, by inserting a variable series resistance. The original resistance wire was discarded, and six discrete resistors fitted.

The circuit shown gives the two effects, fuzz and wah-wah. IC1 (TL072 OR lf353) was chosen for its combination of low-noise, low current drain, relative insensitivity to supply voltage and low cost.

The output of the first stage, IC1a can be adjusted from nearly linear operation, with the fuzz pot RV1 near maximum, to very squared output, with the pot at minimum.

The pot is placed where it is in order to increase the forward gain at the same time as increasing the beedback. The output is divided down by 'buzz' switch SW2, to allow extra spikes to be added.

The second stage consists of a tunable bandpass filter (wah-wah) controlled by FET Q1 (2N5484), via the pedal. At some frequencies, controlled by the feedback network, there is a 180É phase shift in the feedback, which leads to extra amplification of the frequencies in that region.

This is a crude, but audible bandpass filter. The frequency of interest is controlled by the effective resistance between source and drain of the FET. It sweeps roughly over the range 0.5-5kHz.

Because of the stepped nature of the pedal control, it was necessary to provide filtering for the control voltage at the gate of the FET, via switch SW3. The three filter rates used provide interesting variations in the nature of the wah-wah effect, especially the slow position, which tends to surprise the operator due to its long delay (RC = 1s, but subjectively it seems about 3s!)

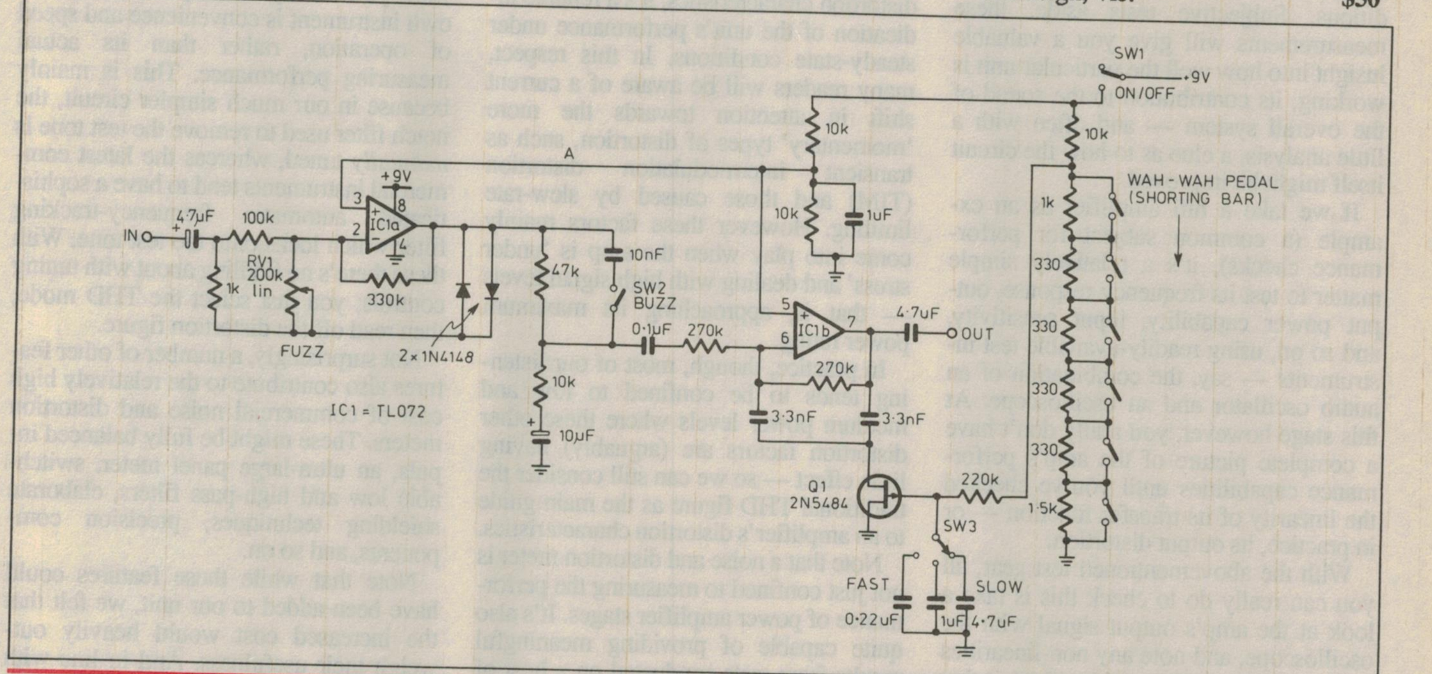
The control voltage steps of the wah-wah pedal were worked out using a potentiometer to calibrate the passband centre frequency, by observing the output waveform ringing when driving the circuit with the buzz facility switched in.

The entire works fit inside the pedal casing, including a 9V battery which is encased in foam rubber to prevent it touching the other circuitry.

Total current gain is 5mA, so battery life should be relatively long. And total cost was about $50, far less than the $200-$400 for similar commercial units.

David Blackwell,
Bentleigh, Vic.

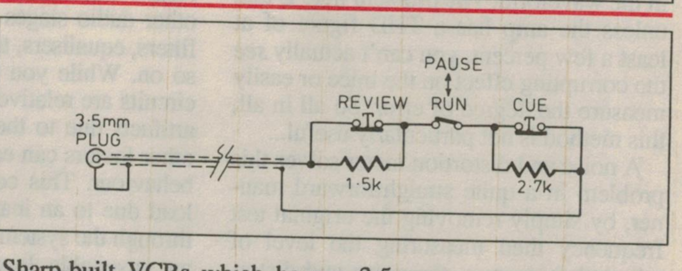
**$50**




## Old VCR remote controls

Some time ago I bought a second-hand nine year old Philips VR501 video cassette recorder which didn't have its wired remote control with it.

Knowing that the Pye and Philips VCRs of that vintage were built by Sharp, I borrowed the remote control from a mate's Pye VRD-022 unit and found that the Philips machine responded correctly to its (limited!) range of commands.




So I disassembled the remote control, copied its circuit as shown above, and built my own using subminiature switches into an empty Colgate dental floss container, connecting it to the VCR with several metres of light-duty single core audio coaxial cable.

This circuit will probably work with most of the early Sharp-built VCRs which have a 3.5mm remote control socket on the back. I've also tried it on a Sharp VC-9100, but only the PAUSE/RUN switch works (this machine has no picture search facility anyway!).

Bob Parker,
Carlton, NSW

**$35**

Construction project:

# Low cost Noise and Distortion meter - 1

**If you design, service, or experiment with audio equipment, this new instrument should fill a yawning gap in your range of test gear. It can measure distortion levels down to less than 0.01% at spot frequencies of 100Hz, 1kHz and 10kHz, as well as providing a built-in low distortion oscillator and AC millivoltmeter. Best of all, it can be built using common off-the-shelf parts.**

**by ROB EVANS**

When it comes to seriously assessing the performance of a piece of audio gear, there is really no substitute for being able to determine its level of total harmonic distortion (THD), under a variety of conditions. Subjective tests aside, these measurements will give you a valuable insight into how well the particular unit is working, its contribution to the sound of the overall system — and often with a little analysis, a clue as to how the circuit itself might be improved.

If we take a hifi amplifier as an example (a common subject for performance checks), it's a relatively simple matter to test its frequency response, output power capability, input sensitivity, and so on, using readily-available test instruments — say, the combination of an audio oscillator and an oscilloscope. At this stage however, you really don't have a complete picture of the amp's performance capabilities until you've checked the linearity of its transfer function — or in practice, its output distortion.

With the abovementioned test gear, all you can really do to check this is take a look at the amp's output signal with the oscilloscope, and note any non-linearities in the waveform. The problem here is that unless the amp has a THD figure of at least a few percent, you can't actually *see* the corrupting effect on the trace or easily measure the degree of error. So all in all, this method is not particularly useful...

A noise and distortion meter solves this problem in a quite straightforward manner, by simply removing the original test frequency then measuring the level of what's left over — the noise and distortion artifacts. Since a non-linear transfer curve (say in a amplifier) will produce a number of smaller signals which are harmonically-related to the test tone (the distortion by-products), these can just be measured in total and expressed as a percentage of the fundamental tone's amplitude (in %THD).

While the THD figure certainly doesn't tell the *whole* story regarding an amp's distortion characteristics, it's a reliable indication of the unit's performance under steady-state conditions. In this respect, many readers will be aware of a current shift in attention towards the more 'momentary' types of distortion, such as transient intermodulation distortion (TIM) and those caused by slew-rate limiting. However these factors mainly come into play when the amp is 'under stress' and dealing with high signal levels — that is, approaching its maximum power rating.

In practice, though, most of our listening tends to be confined to low and medium power levels where these other distortion factors are (arguably) having little effect — so we can still consider the traditional THD figure as the main guide to an amplifier's distortion characteristics.

Note that a noise and distortion meter is not just confined to measuring the performance of power amplifier stages. It's also quite capable of providing meaningful results from tests conducted on a host of other audio stages — such as pre-amps, filters, equalisers, tone control stages, and so on. While you may expect that these circuits are relatively free from distortion artifacts due to the low power involved, other factors can easily induce non-linear behaviour. This could be a signal overload due to an inappropriate gain profile through the system, output limiting due to an unsuitable load impedance (say too low), or even dirty switch contacts. So while the practical value of such an instrument is clear, most of us haven't the funds to purchase a commercial noise and distortion meter, which tends to have a price tag in the order of thousands of dollars. But as you have no doubt gathered, the instrument described here can be built for a small fraction of that price.

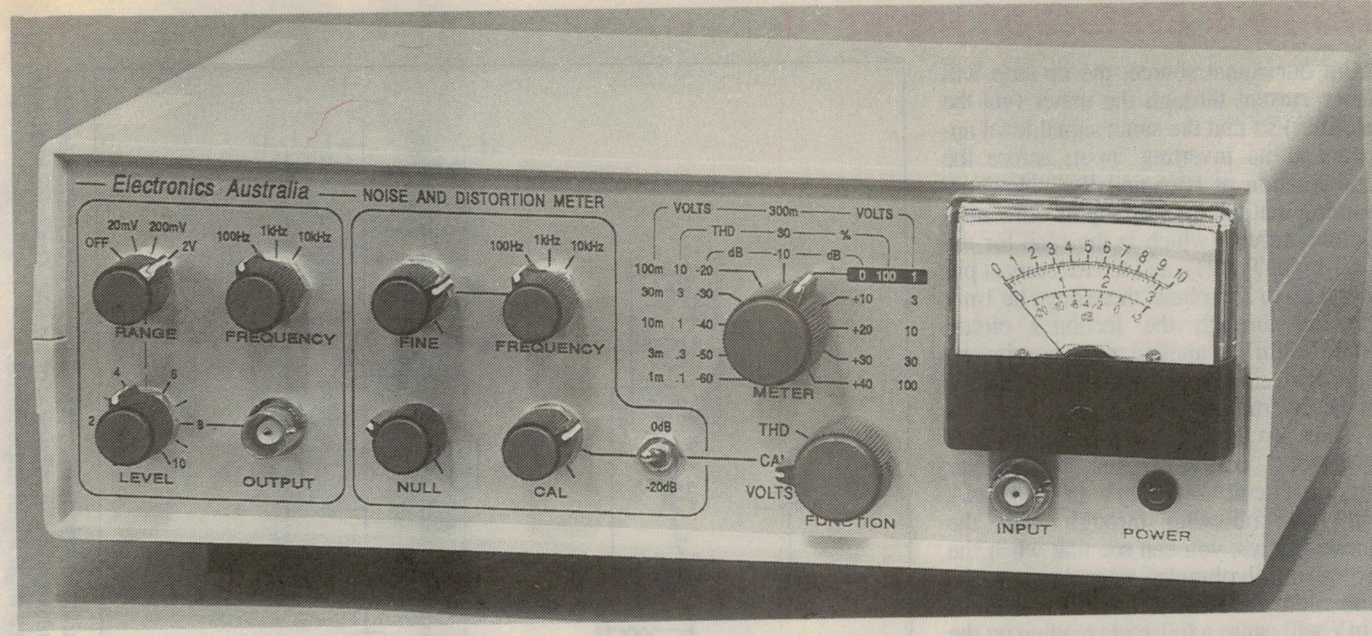
It's interesting to note that in this case, what you mostly lose by building your own instrument is convenience and speed of operation, rather than its actual measuring performance. This is mainly because in our much simpler circuit, the notch filter used to remove the test tone is *manually* tuned, whereas the latest commercial instruments tend to have a sophisticated automatic frequency-tracking filter which locks onto the test tone. With these there's no fiddling about with tuning controls; you just select the THD mode, then read off the distortion figure.

Not surprisingly, a number of other features also contribute to the relatively high cost of commercial noise and distortion meters. These might be fully balanced inputs, an ultra-large panel meter, switchable low and high-pass filters, elaborate shielding techniques, precision components, and so on.

Note that while these features could have been added to our unit, we felt that the increased cost would heavily outweigh their usefulness. And in line with our current range of low-cost test gear projects, we took a careful look at what's really needed for a cost-effective and practical device, and included the functions accordingly. Of course some constructors may wish to make a more sophisticated instrument by building the unit as described, then adding the additional features mentioned above.

As it stands however, our new low cost noise and distortion meter delivers more than creditable performance, and above all, is an extremely useful instrument for those involved with audio circuits.

In terms of features, it has its own built-




in reference oscillator (a feature missing on many commercial units) with a distortion level of less than 0.003% at 1kHz, and a measurement circuit with a bandwidth of around 200kHz and a dynamic range of about 90dB. So in practice it's capable of reading noise and distortion level down to less than 0.01%, and will detect up to the fifth harmonic signal of the 10kHz test tone, which is more than adequate for most applications.

## Circuit description

As you can see from the schematic diagram of the new meter, the circuit can be split up into a number of discrete sections which combine to form the total instrument.

Starting with the reference signal, the oscillator stage is based on a standard Wien bridge network formed by C10 to C15 and R18 to R21, where switch SW5 (Frequency) selects the appropriate capacitor for each test frequency. The network controls the positive feedback around IC6, a 5534 high-performance op-amp, which will oscillate when its closed-loop gain is greater than unity.

In turn, the loop gain is controlled by the stabilising network formed by RV7, R22 and lamp LP1, which sets the level of *negative* feedback around IC6. Thanks to the positive temperature coefficient (PTC) characteristic of the lamp's filament, the network will increase the level of negative feedback when the op-amp's output level rises, thereby decreasing the loop gain and stabilising the oscillator output level.

To understand this effect, remember that the lamp's filament will heat up (and its resistance will rise) as it dissipates a little more power in response to a larger signal across the network — which of course, is driven from the oscillator's output. By simple voltage divider action, this causes more of the output signal to appear at the op-amp's inverting input (pin 2), which acts to reduce the level at the output by negative feedback action. And as you would expect, a *reduction* in the output level will cause the lamp to cool, which decreases the feedback and causes the output to rise again.

By the way, the basic oscillator stage of our new instrument is virtually identical to that of the sine/square wave oscillator presented in the March 1992 issue of *Electronics Australia*. The only real difference is that the original circuit has a set of back-to-back zener diodes across the stabilising network, which were added to reduced the amplitude bouncing effect common to most Wien bridge oscillators. Since the bouncing effect is most troublesome when the oscillator's frequency is swept by a continuous control (usually a pot) these zeners could be omitted from our new circuit, as it has just three *switched* frequencies.

While the oscillator's output does bounce for a moment when the frequency is changed, it's not really a problem for this application. The point is however, that the oscillator's distortion is much lower with this arrangement — according to the rather more elaborate distortion meters in our lab, it's in the order of 0.002% at 1kHz.

Getting back to the actual circuit, the oscillator's output is coupled to the level control RV8 via isolating/protection resistor R23, then passed to the output attenuator formed by R24 to R27 which provides the output levels as shown. The appropriate level is then picked off by the range switch SW6 and passed the oscillator's main output.

Now let's look at the measurement section. If we consider for the moment that the instrument is in its basic voltage measurement mode, the signal at the main input socket will be connected directly from SW1a to SW1b, which will be in the VOLTS position as shown. This in turn passes the signal to the meter attenuator network (R28 to R39) via coupling capacitor C17.

The attenuator is arranged in 10dB steps as shown, and is connected directly to the meter attenuator switch SW4, which connects the selected 'tap' to a high-gain voltage amplifier based around IC3 and IC4.

IC3, a TL071 FET-input op-amp, is arranged as a simple unity gain buffer in order to provide a high impedance load to the preceding attenuator, and a low impedance driving stage for the main voltage amplifier IC4. In this case, the 5534 op-amp is configured for a gain of 256 (48dB) by the feedback resistors R40 and R41. So if we have an input to this stage of say 1mV (its rated sensitivity), the voltage amp will increase this to a level of 256mV, which is then passed to meter driving amplifier based around the TL072 op-amp IC5.

Here, C19 couples the signal to the op-amps non-inverting input (pin 3), R43 references the input to ground potential, and R42 passes the signal to the CRO output socket. The circuit is arranged with the meter (M1) and its bridge rectifier (D1 to D4) in the op-amp's negative feedback loop, which is terminated by resistors RV6 and R44 at the inverting input (pin 2).

Since the non-inverting input is driven

from our signal source, the op-amp will drive current through the meter (via the rectifier) so that the same signal level appears at its inverting input, across the combination of RV6 and R44. Now, assuming that the op-amp inputs draw negligible current (which is the case for the FET-input TL071), and the resistors at pin 2 add up to 256 ohms, there must be 1mA flowing through the feedback circuit when 256mV is applied to the non-inverting input, since there will also be 256mV at the inverting input.

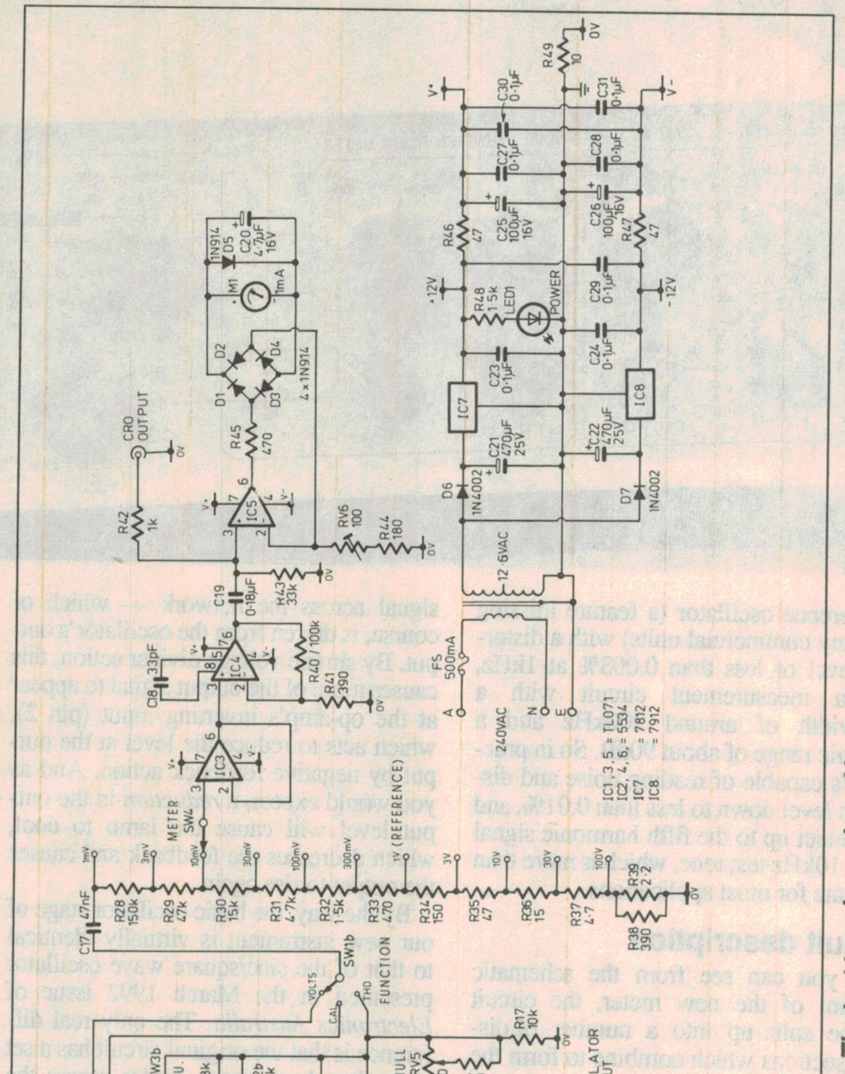
Thus we effectively have a voltage-to-current converter for our meter driving circuit — 256mV in, and 1mA out. By following through with the above figures, you can see that when the overall millivoltmeter stage is set to its maximum sensitivity, an input level of 1mV will cause a full-scale reading on the 1mA meter.

The other components in the meter circuit are mainly included to protect the meter movement, where in the event of overload R45 will limit the maximum current through the meter, and diode D5 restricts the voltage across its terminals. Also, note that C20 is connected across the meter to filter the rectified signal and reduce needle 'jitter' at low frequencies.

So that's about it for the basic test tone and millivoltmeter stages. When the unit is switched to measure distortion however, the signal is passed through the notch filter stage based around IC1 and IC2, where the essential aim is to remove the original test tone so the remaining artifacts (distortion and noise) may be measured by the millivoltmeter. Before this can happen though, the unit needs to be calibrated to suit the input level of each test.

In the calibrate mode, SW1a (which is now in the CAL position) passes the input signal to the attenuator formed by R1, R2, SW2 and RV1. When the input attenuator switch (SW2) is open the signal across RV1 is reduced by 20dB, and when closed the input is coupled directly to the Cal pot (RV1). In turn, RV1's wiper passes the signal to a buffer stage (IC1) via a high-pass filter formed by C1 and R3 — this is set to about 8Hz, so as to reduce the level of unwanted sub-sonic signals.

The buffer circuit based on IC1 provides a high input impedance for the preceding stage, and is configured for a gain of 1.47 (3.3dB) by the feedback resistors R4 and R5 so as to add a little extra gain to 'play with' during calibration. Its bandwidth is restricted to around 200kHz by C2, and the output also drives an attenuator network based on RV3 and



**Here's the complete schematic for the noise and distortion meter. The test tone is produced by a conventional Wien bridge oscillator formed around IC6 (shown in the lower left-hand corner of the diagram), while the notch filter (upper left) uses a similar bridge to control the negative feedback around IC2. The millivoltmeter circuit uses three op-amps (IC3 to IC5) to achieve a low-noise high-gain stage, that is both stable and offers a high input impedance.**

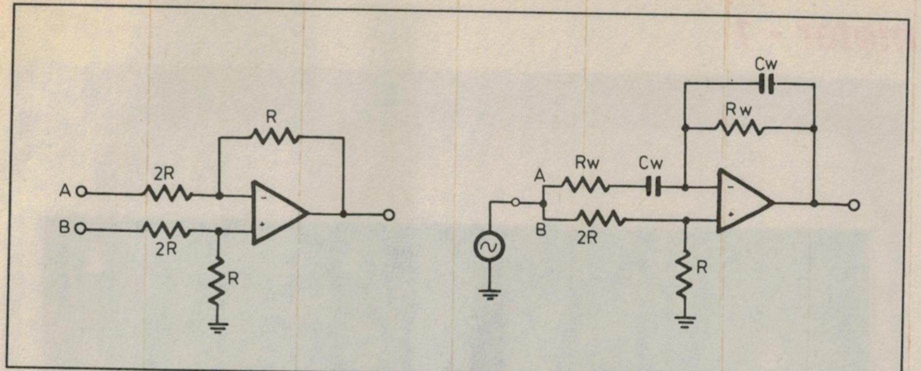



***Fig.1 (left) shows a standard differential amplifier, while Fig.2 (right) shows how this arrangement is used in the instrument's notch filter — note that in this case, inputs A and B are connected together so that the stage is rejecting common-mode signals when the two feedback paths are in balance.***

R6 — which is in fact the signal path when the instrument is in its calibration mode, as you can see from SW1b.

The idea here is that RV3 can be adjusted to provide an attenuation which matches the slight loss through the notch filter, experienced by frequencies outside of the actual 'notch' — this is only about 1dB, while signals at the notch frequency are reduced by at least 90dB. So despite this small loss, the same general signal level will arrive at the CAL and THD positions of SW1b, once the trimpot RV3 has been set.

When it comes to actually calibrating the instrument for a given input level (say, a 5V signal from a low-powered amplifier), the Cal control (RV1) is adjusted to reduce the signal level through the circuit until the meter is accurately reading full-scale on the 0dB/100%/1V range — this is our reference level for distortion and noise measurements. For much larger input signals (say 50V), the attenuator switch (SW2) can be moved to the '-20dB' position, reducing the level by a factor of 10.

By the way, it's important to note that you can only calibrate the instrument for input levels greater than about 0.8V, since the overall filter section has a gain of about 1.25 (+2dB). And perhaps more to the point, the unit may not have enough dynamic range to make accurate noise and distortion readings with lower level input signals (this is also the case with most commercially made noise and distortion meters).

When the function switch is then turned to THD, the signal for the millivoltmeter is taken from the output of the notch filter by SW1b. The notch filter itself is a little unusual in that while it uses a Wien bridge network for the negative feedback path around IC2, the circuit itself acts rather like a frequency-selective differential amplifier.

Referring to the circuit diagram, the Wien bridge is formed by capacitors C3 to C8 (as selected by SW3a and SW3b), R9 and R10, and RV2a/b with its shunt resistors R7, R8, R11 and R12. As you can see from the schematic, this bridge is of the same impedance as the one used in the reference oscillator circuit (around IC6) since the same value capacitors are used for each frequency range. This has been done for component tolerance reasons, as discussed later.

To understand the operation of the notch filter, first consider the simple differential amplifier shown in Fig.1. Here, a signal applied *between* the A and B inputs will be passed to the output (with a gain of 0.5), while signals *common* to both inputs are rejected.

So if we actually connected the two inputs together and applied a signal at this point (referenced to ground), we can expect virtually no output from the stage as this is a 'common-mode' signal. In practice, the output level will depend on the common mode rejection ratio (CMRR) of the stage, which is set by the accuracy of its resistance values and the CMRR of the op-amp itself.

It's the above arrangement that's used in our notch filter, as shown in its simplified form in Fig.2. In this case however, the resistors at the op-amp's inverting input have been replaced by a Wien bridge network, shown here as capacitors Cw and resistors Rw — 'w' standing for Wien. The bridge's tuning frequency is equal to $1/(2\pi RwCw)$.

The characteristic of the Wien network means that at the tuning frequency there is zero phase shift through the circuit (it's purely resistive), and the resistance of the series arm is exactly double that of the parallel arm. Note that while the resistance involved may not actually *equal* 2R and R, it's in the correct two-to-one ratio and the circuit is operating as the abovementioned differential amp, with its inputs tied together.

So at the tuning frequency, the signal appears as a common mode signal to a differential amp, and the output is zero. In real terms however, the output level will depend upon (mainly) the CMRR of the op-amp itself — fortunately, the 5534 op-amp used in our circuit has a very respectable CMRR figure of about 100dB.

Just how the circuit responds to signals of higher and lower frequencies is a little more difficult to explain, as it happens. Rather than attempting to analyse the phase relationships involved, it's probably sufficient to just consider the circuit's response to very high and very low frequencies. Nevertheless, it's worth noting that the Wien network has a phase shift of 90° at low-frequencies, passes through 0° at the tuning point, then swings to +90° at higher frequencies.

Referring to Fig.2 again, imagine that the two capacitors are offering a very high impedance, as would be the case when the input signal is at a low frequency. Since they are no longer influencing the circuit, the only *bridge* component playing a part is the resistor (Rw) connected from the op-amp's output to its inverting input.

As the op-amp is now simply acting as a unity gain buffer, the signal at its non-inverting input will appear at the output at

the same level. And since this input is supplied by the voltage divider formed by the two remaining resistors (which have values of 2R and R), the final output will be about 9.5dB less than the input level — that is, a stage gain of 0.33.

Conversely, when the input signal is at a very high frequency, the two bridge capacitors will be exhibiting a very low impedance. In this case, the capacitor in the parallel arm will connect the op-amp's output directly to its inverting input, again forcing it to act as a unity gain buffer. The other capacitor will simply connect the series arm resistor between the signal source and (effectively) the op-amp's output, so this resistor will have little effect — remember that in our real circuit, the signal source is IC1 which offers a *low* driving impedance.

So by looking at the circuit in this relatively simple manner, you can see that for signals which are not at the notch tuning frequency, the circuit has a consistent gain of about -9.5dB (0.33).

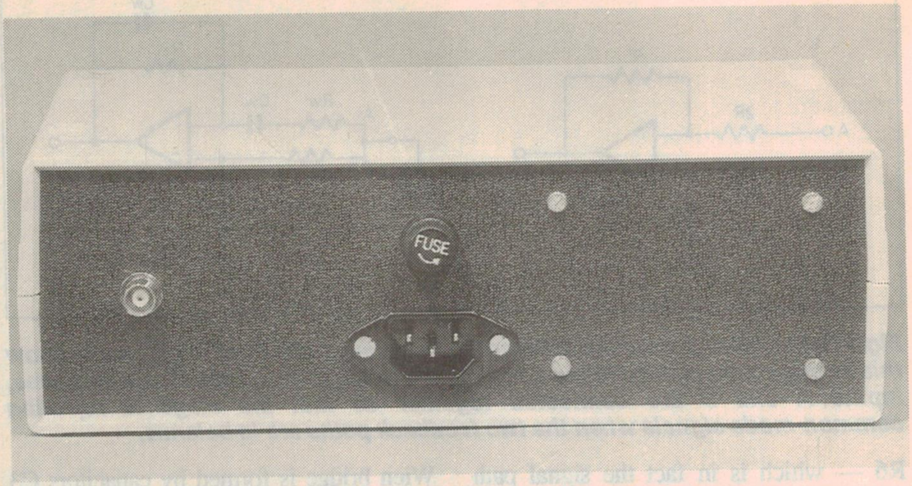
Referring back to the schematic diagram, note that our R/2R voltage divider (at the B or +ve input of the 'diff-amp') is composed of resistors R13 (2R) and the combination of R14, RV4 and RV5/R15 (R). In this case however, the latter resistor chain (R) is not connected directly to ground, as was the case in our simplified circuit(s). It is in fact terminated at the junction of R16 and R17 — a voltage divider fed from the notch filter's main output at pin 6 of IC2.

This gives the filter an added level of *positive* feedback, which both tightens the notch width and increases the overall gain from -9.5dB to about -1dB. The actual amount of positive feedback is set by the ratio of R16 and R17, and in practice, is a balance between the circuit's stability and the 'sharpness' of the notch. If there's too much feedback the filter tends to oscillate, while an insufficient level will broaden the notch to a point where the test tone's first harmonic signal may be attenuated — this would give an overly 'favourable' THD reading.

As you expect from any circuit operating as a differential amplifier, its ability to reject common mode signals will depend upon the balance or matching of the two input circuits.

In our case, this is addressed by the Null control (RV5) which varies the overall resistance in the 'R' leg of the non-inverting input, allowing you to 'tune' the resistance ratio at this input to match that of inverting input.

The remaining section of the schematic shows the unit's regulated power supply.




***Like some less inanimate objects, the unit's rear end is wide, functional, and visually unappealing...***

This is quite a simple arrangement, where the transformer's 12.6V secondary voltage feeds half-wave rectifiers D6 and D7, which are followed by filter capacitors C21 and C21.

The resulting two supply rails of around +/-17V are then applied to 12V regulators IC7 and IC8, which produce stable +/-12V rails to drive the unit's reference oscillator (IC6) and the following supply filters based on R46 and C25 (positive rail), and R47 and C26 (negative).

The output from these additional filters (V+ and V-) then feeds the remaining circuitry, which because of its sensitive nature, would otherwise be effected by supply rail interference from the oscillator.

Other power supply parts include the power indicating LED and its limiting resistor R48, which are supplied by the +12V rail, and the ground isolating resistor R49. This 10-ohm resistor is included to separate the earth paths of the sensitive sections of the instrument from those of the oscillator and power supply.

Other than that, the schematic also shows a number of 0.1uF bypass capacitors connected to the supply rails. These are included to ensure the circuit's high-frequency stability, and are fitted in various locations around the boards.

## Hardware and components

As you can see from the shots of the prototype, the noise and distortion meter's circuitry is arranged on three separate circuit boards, and is housed in a standard 'large' (260 x 190 x 80mm) plastic instrument case.

As it turned out, we needed the biggest box in the range in order to gain sufficient front panel space for the large number of controls and their associated labelling, rather than the need for generous internal area for the circuitry itself. In fact the completed instrument has plenty of room left inside the case, as you can see.

The power supply, oscillator and notch filter are all contained on the main circuit board (coded 93ndm3a), which measures 116 x 64mm and mounts into the bottom of the box just behind the front panel. The remaining millivoltmeter stage is split into two sections, with the attenuator/amplifier circuitry contained on a small PCB coded 93ndm3b (measuring 64 x 45mm), and the meter driving circuit held on an even smaller PCB coded 93ndm3c (64 x 36mm). These two boards mount behind the meter attenuator switch (SW4) and the meter itself, respectively.

While this multiple circuit board arrangement makes the construction process a little more complicated — due to the extra wiring needed for interconnecting the PCBs — it does result in a very stable millivoltmeter stage. These circuits tend to be rather troublesome when built on a single, compact circuit board.

This point became clear during the initial design stage, when we noticed that the switching action of the meter rectifier diodes (D1 to D4) was generating sufficient interference to be picked up by the high gain, high input impedance stage based on IC3 and IC4.

When the rectifier and input stages are physically separated (and their earth paths isolated) the circuit performs in a far more stable manner.

You may also notice that the two larger circuit boards have been fitted with similarly-sized pieces of *blank* PCB, which have been attached to the underside of each board with their copper sides facing away from the main PCB.

The idea here is that when the copper is

connected to ground potential, these additional boards act as shielding for their host PCBs, without the expense or complications of using double-sided board for the unit's circuitry. However, if you are planning to use a metal rather than plastic case, or don't need to measure very low levels of distortion, these extra shielding boards could be omitted.

Another point to consider before you commence construction is the component tolerances in the Wien bridge section of both the notch filter, and the oscillator. While it's not really necessary to use *close* tolerance components in the two bridge circuits, a number of key components should be *matched* in value so that the oscillator and notch filter are tuned as closely as possible to the same frequency.

If this was not the case, the unit's fine frequency control may not have enough range to adjust the notch to the oscillator's test frequency. For example, if the notch can be tuned between say 950Hz and 1050Hz, the oscillator's frequency must be within this range — ideally, 1kHz.

As it turns out, it's the main tuning capacitors C3 to C8 (notch filter) and C10 to C15 (oscillator) which will have the largest effect on the tuning frequency rather tnan the resistive arms of the bridges, since off-the-shelf capacitors tend to have a much wider variation in their rated value than the common 5% tolerance resistors. And the resistive arms of the notch filter include the variable resistors RV2a and RV2b (the 'fine' frequency control), so close-tolerance resistors would be of limited benefit here.

The simplest way to ensure that the capacitors are reasonably close in value is to pick each set (there's a total of four per frequency range) from the same batch, or in practice from the same parts bin. In this case you should find that while their values may be say 10% high, the variation between each unit might only be 2%, since they were produced during the same manufacturing run.

The end result with this system is that *both* the oscillator and the notch filter will operate at a lower frequency (say 900Hz rather than 1kHz), which means that the fine tuning control will automatically operate over the correct range (say 855Hz to 945Hz).

While selecting components from the same batch should satisfy the tolerance requirements for the circuit, it may pay to double check their values with a capacitance meter before you begin the construction, just to make sure.

If you find that one or two of the values don't fit the batch 'trend', this can generally be overcome by considering where they are installed in the bridge circuits.

For example, you may have four "47nF" capacitors which measure; 49nF, 50nF, 45nF and 53nF. Since the Wien bridge's tuning frequency is equal to the reciprocal of $2\pi RC$, where C is the *average* value of the two capacitors involved, it makes sense to use the 49nF and 50nF for one circuit (say the notch filter; C5 and C8), and the remaining two values for the oscillator bridge (C10 and C15).

With this arrangement, the average capacitance for the notch bridge is 49.5nF (49nF and 50nF), while the oscillator will respond to an effective value of 49nF (45nF and 53nF). Thus the tuning frequencies will end up being quite close, despite the variation in the capacitor values.

Of course the two capacitors in a Wien bridge should really be as close in value as possible, if the circuit is to exhibit its normal transfer function — that is, a peaked amplitude response, with a gain of one third and zero phase shift at the 'tuning' frequency.

In the above case where two quite different values are used however (45nF and 53nF), the only significant change in the bridge's characteristics is that its peak gain is (theoretically) reduced from 0.333 to 0.313. However, thanks to the oscillator's lamp stabilising network, this change is automatically corrected.

It's important to note that since the oscillator circuit will conveniently correct for a loss of gain in the Wien network, it's *this* bridge that should be fitted with the capacitors which are most in error (but 'averaged'), rather than the notch filter's bridge. This is because in the latter circuit, any change in the network losses must be manually corrected with the unit's Null control (RV5), which like the Fine control, has a relatively small adjustment range.

Finally, you will need to obtain a miniature lamp that is suitable for the oscillator's stabilising network. As in the Sine/squarewave oscillator from the March 1992 issue, a replacement lamp for a standard alarm warning light does an excellent job, and should be quite easy to track down. While this has a rating of 12V at around 50mA, just about any similarly rated lamp should do the trick since the circuit can be adjusted over a wide range by RV7.

That's about it for the circuit and parts considerations for our new noise and distortion meter. Next month, we'll look at its construction, calibration and use.

*(To be continued)* ❖

## The Cedar Process

*Continued from page 19*

**Phase/Time Correction**: A lot of problems can be blamed on timing errors between left and right channels — such things as azimuth errors on tape recorders. CEDAR's digital time correction system is accurate to .01 of a sample. Left and right channels can be shifted against each other by very high subsampling amounts, via auto tracking — as well as manually.

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Some customers demonstrated a need for a way to run a restoration session through onto the CEDAR system PC's hard disk, and then apply the standard editing facilities to the material.

Restoration can now be performed en route to the hard disk or in the offloading process. An SMPTE Time Code facility allows full control of outboard peripherals. CEDAR's processors work in the time, not frequency, domain. A click is detected and replaced with the best judgement of signal. 'Real time' means there is a delay of no more than 1/10th of a second for the processing.

Reid stressed it was "not a section of adjacent signal, but a version of re-synthesis or interpolation using all the information available within the signal to make a judgement as to what was there before the click destroyed the signal".

CEDAR is a modelling system, software-based and algorithmic, comparing the genuine signal coming from the source machine with a model of that genuine signal, including certain assumptions that the system has learnt. As Reid says, "The quality of those assumptions defines whether the system works properly or not".

The price of success, in this case, is invisibility. Some big companies use CEDAR systems, but are frightened to put CEDAR logo's on their releases because they feel it reflects badly on them or may warn off highbrow audiophiles who believe in the sanctity of the original signal.

Maybe it's a case of 'If you've got it, don't flaunt it'!

Note: The Australian agents for CEDAR are D.W. Productions, of 11b/3 Kenneth Street, Manly Vale 2093; phone (02) 907 9638, fax (02) 907 9687. ❖

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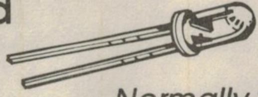

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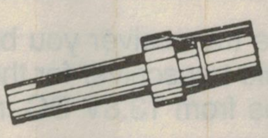

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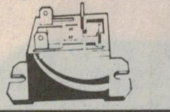

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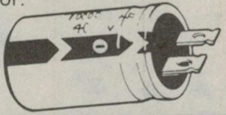

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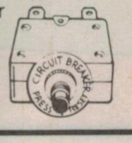


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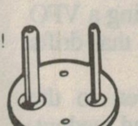

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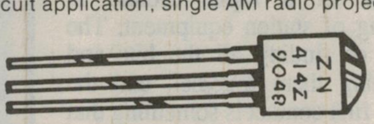


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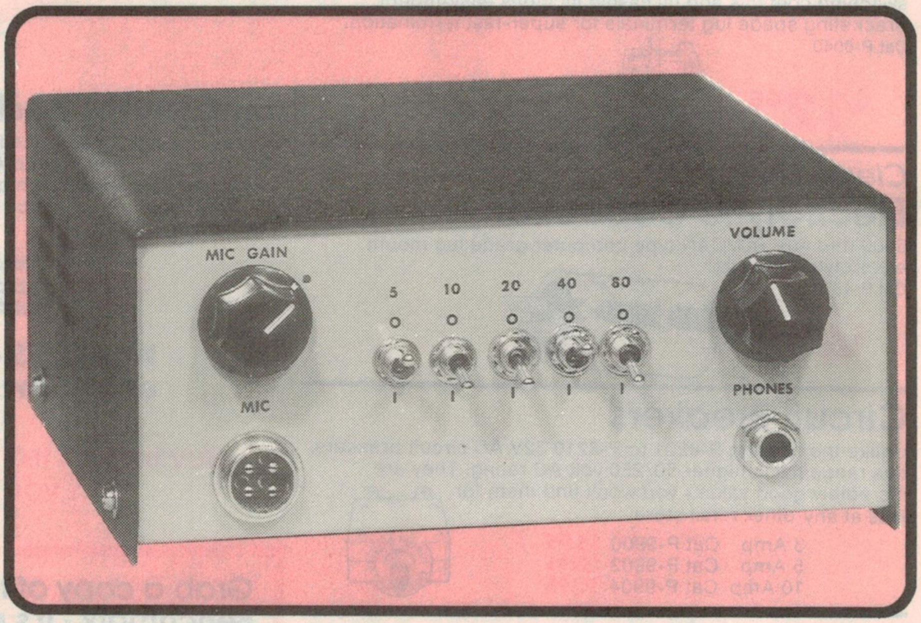
## Construction Project:

# A low cost 80m DSB transceiver - 1

**Discover the thrill of talking to other radio amateurs, with a transceiver you built yourself. Using a PLL frequency synthesizer for drift-free operation, this simple transceiver for the 80m amateur band is compact, inexpensive and easy to build. It also operates from 13.8V DC, making it suitable for portable operation if desired.**

**by LEON WILLIAMS, VK2DOB**




One of the great advantages of an amateur radio licence is that it allows amateurs to build and operate their own transmitters and receivers. The last couple of decades, however, has seen the proliferation of 'black boxes' — which has resulted in a rapid decline in homebrewing of station equipment. The satisfaction of finding all the bits and pieces, putting them together, and the thrill of that first contact is something that a lot of new amateurs unfortunately no longer experience.

The arguments against home construction generally relate to the average amateur being unable to construct transceivers equal to those which are currently commercially available.

This is generally true, of course, but what most people fail to realise is that it is not necessary to have a $3000 transceiver with a hundred knobs, computer control and 400 watts output power to talk to friends across town or across the country.

This transceiver has two knobs, an output power of around six watts and yet I have had many enjoyable contacts with it. Reports have been very complimentary, and in fact most other stations are unaware unless you tell them that you are operating low power ('QRP') and double sideband (DSB).

Over the years there have been many designs for QRP transceivers published in various publications, but with the odd exception they have all been for CW operation. This design fills the need for a simple voice transceiver that should provide a lot of satisfaction for those who build and operate it.

The main feature of this design is the use of a PLL (phase-locked loop) frequency synthesizer. This overcomes the old annoying problem of building a VFO (variable-frequency oscillator) that drifts in frequency.

A lot of thought was given to the method of frequency setting and readout. The technique of using binary-weighted toggle switches is unusual, but provides the cheapest and most convenient method of those considered.

The transceiver is built on two double-sided printed circuit boards. The first of these comprises the PLL frequency generator, which provides 5kHz tuning steps programmed using the front panel switches.

The second and larger board contains the remaining circuitry, that is, a direct conversion receiver and a DSB transmitter. The output stage uses a power FET, develops between six and eight watts PEP output and has proved virtually indestructible. The unit is powered from a standard 13.8V DC supply and housed in an inexpensive case.

Operation is simply a matter of connecting the power supply, an antenna, a microphone, headphones or a speaker, setting the frequency switches and talking.

### DSB versus SSB

You may have asked the question, why build a double sideband transmitter when just about every high frequency transmitter uses single sideband (SSB)? The answer to this is quite easy — a DSB transmitter is both simpler and cheaper to build!

It is true that extra bandwidth is required, and this must be taken into consideration on a crowded band, but the

advantages to the home constructor greatly outweigh the disadvantages.

Fig.1 illustrates the main differences. A SSB transmitter uses a narrow filter to filter out the unwanted sideband. The frequency of this filter is fixed, so if we wish to operate on frequencies other than the sideband filter frequency a mixer is required to translate the signal to the wanted frequency. SSB filters can be homebrewed, but the process is not straightforward, while commercial filters are too expensive for use in simple homebrew designs.

By comparison, a DSB transmitter as shown in Fig.1(b) is much simpler and more straightforward.

The receiver used in this design is a direct conversion type. This means that there isn't an intermediate frequency. The signal from the antenna is mixed directly with a local oscillator signal on the same frequency, to produce the audio signal. This technique means that a narrow filter to remove one sideband cannot be used, resulting in equal response to both upper and lower sideband.

A hidden advantage of using a direct conversion receiver coupled to a DSB transmitter is that the operator is less likely to cause interference to nearby stations. The reason for this is that the operator will listen on the band with the receiver first, and if there are no signals heard then the operator knows that the DSB transmission will not interfere with SSB operators nearby.

A further advantage of a DSB transmitter/direct conversion receiver combination is that the transmitting and local oscillator frequencies are identical, allowing the use of a single common frequency synthesiser — with no need for a transmit/receive frequency offset.

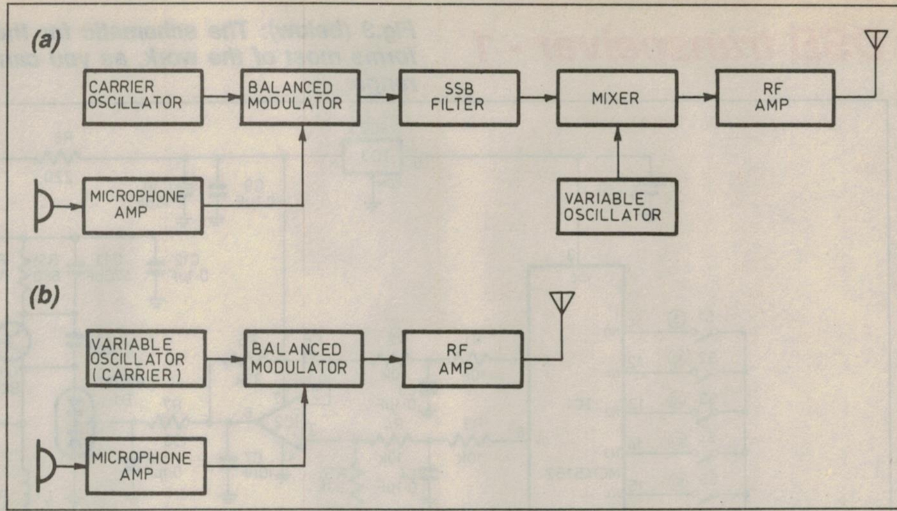



***Fig.1: Block diagrams for an SSB transmitter (a), and a DSB transmitter (b). A DSB transmitter ends up rather simpler, as you can see, as it does not require a second mixer or filter circuit — and only requires a single carrier oscillator.***

## PLL synthesiser

The block diagram for the frequency synthesiser is shown in Fig.2. The heart of the circuit is a dedicated PLL IC, the Motorola MC145152. The circuitry surrounded by the dashed lines is all contained within the IC. A 10.240MHz crystal is divided by 2048 to give a fixed 5kHz reference signal on the first input of the phase detector. The second input of the phase detector receives a nominal 5kHz signal derived from the synthesiser's VCO (voltage-controlled oscillator) output, via the programmable divider.

The phase detector develops an error voltage when the frequency and hence the phase of the two 5kHz signals is different. The error voltage is passed through a low pass filter, which removes the high frequency components.

The polarity of the error voltage is such that it forces the VCO to move in frequency to maintain the 5kHz signal at the second phase detector input. At this point the loop is said to be locked, hence the name 'phase-locked loop'.

The output of the VCO is buffered to stop the applied load affecting its operation. The output signal of the buffer splits in two directions. Firstly it is applied to the transceiver circuits, and secondly it is applied to the programmable divider. This divider divides by a value set by its binary weighted inputs.

In this application the division ratio is between 704 and 735, using the front-panel switches. Considering that the loop is locked when the output of the programmable divider is 5kHz, then the VCO frequency range must be between 5 x 704 = 3520kHz, and 5 x 735 = 3675kHz.

Those who have access to the

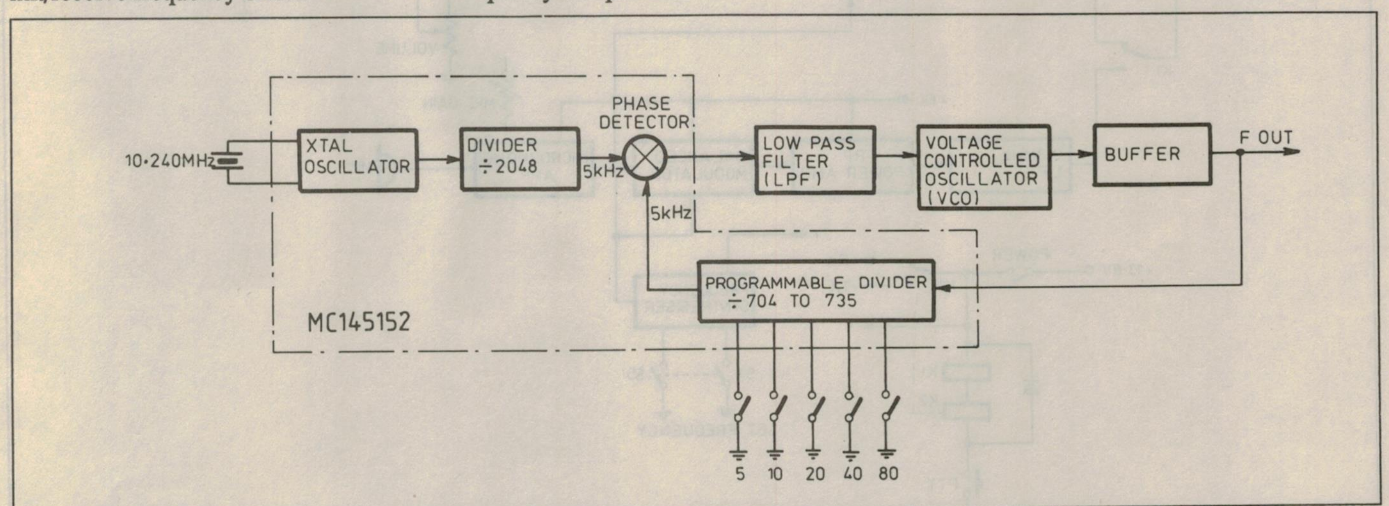
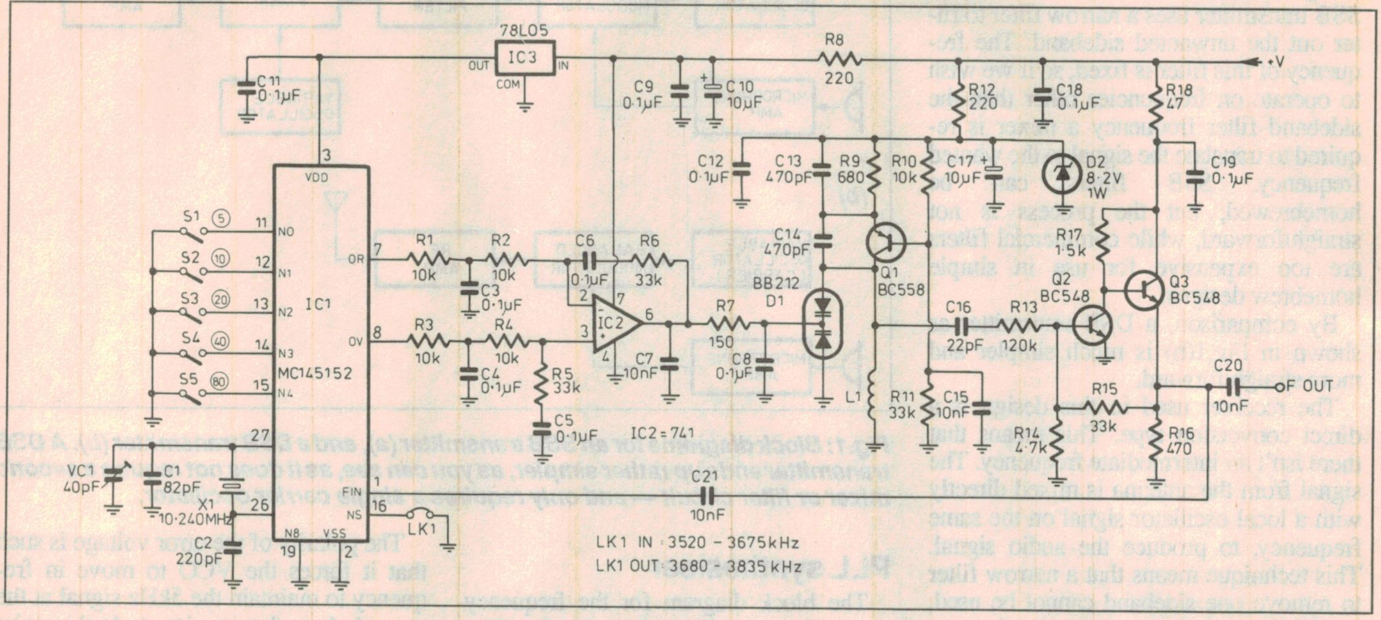



***Fig.2: A block diagram of the frequency synthesiser section of the transceiver. Five toggle switches are used as an economical way to set the operating frequency. The circuit is simpler than you'd expect, thanks to the use of an MC145152 dedicated PLL chip from Motorola.***

# DSB transceiver - 1

***Fig.3 (below): The schematic for the frequency synthesiser section. IC1 performs most of the work, as you can see. Link LK1 sets the frequency tuning range.***




MC145152 data sheets will have noticed that it contains another programmable divider. This is called the 'A' divider, and is used when a dual modulus prescaler is used. In this design it is not required.

It will be noted that the synthesiser's range does not cover the whole of the 80m band. Unfortunately a wider range would have required extra switches and was not considered worthwhile. This transceiver is a voice unit only and so the loss of the bottom 20kHz of the CW section of the 80m band was not thought to be a serious problem. To cover above 3675kHz, an extra switch can be used; this will be discussed later on.

The schematic diagram for the synthesiser is shown in Fig.3. IC1 is the PLL IC. Pins 27 and 26 are the connection points for the internal reference oscillator. The capacitors around X1 provide the required feedback to maintain oscillation. Trimmer VC1 allows the crystal to be pulled exactly on frequency.

Pins 11 - 15 are the programmable divider inputs, used with the toggle switches. The divider inputs have internal pull-up resistors and so are considered to be at logic '1' when the switches are open and at '0' with the switches closed.

The output frequency is simply calculated by adding together the values of the required switches and adding this to the base frequency of 3520kHz. For example if switches S1, S3 and S5 were closed the frequency would be: 3520 + 5 + 20 + 80 = 3625kHz.

This may at first seem complicated, but once you have done it a few times it be-

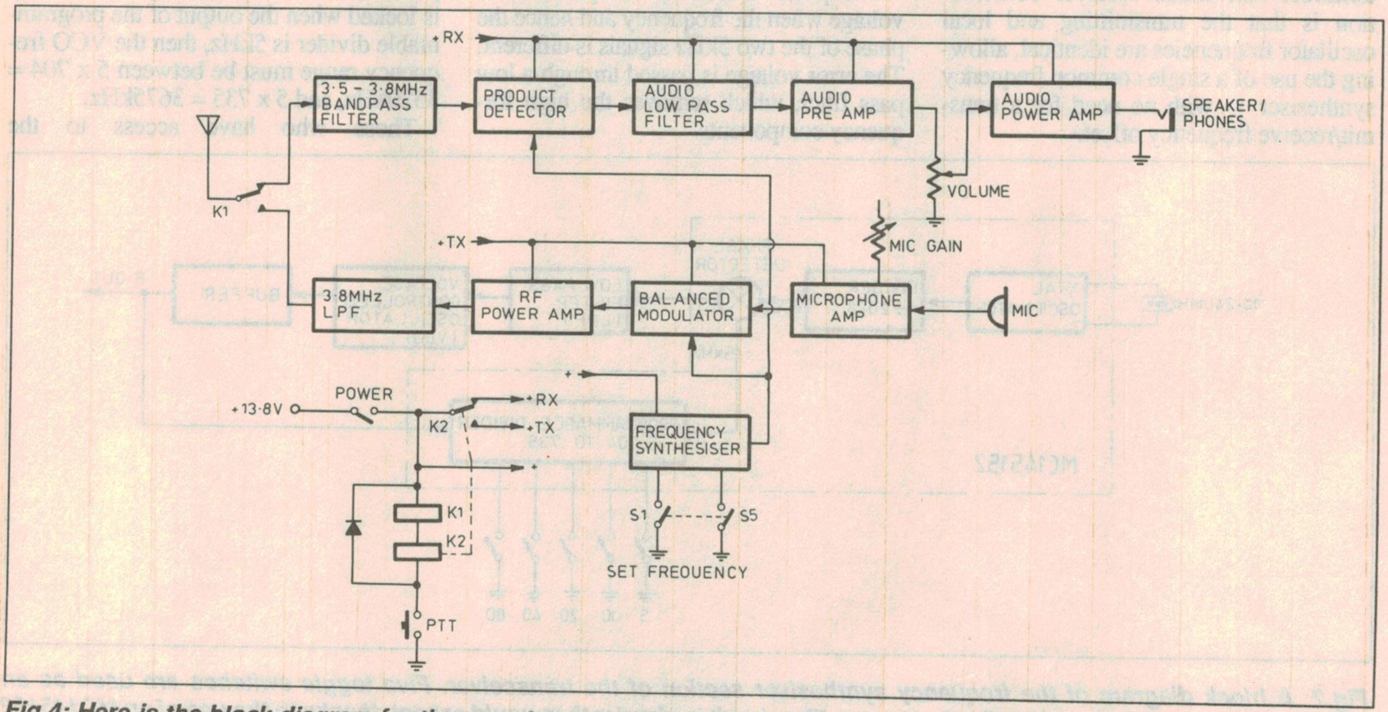



***Fig.4: Here is the block diagram for the complete transceiver. The frequency synthesiser section operates continuously and feeds both the receiver and transmitter sections directly.***

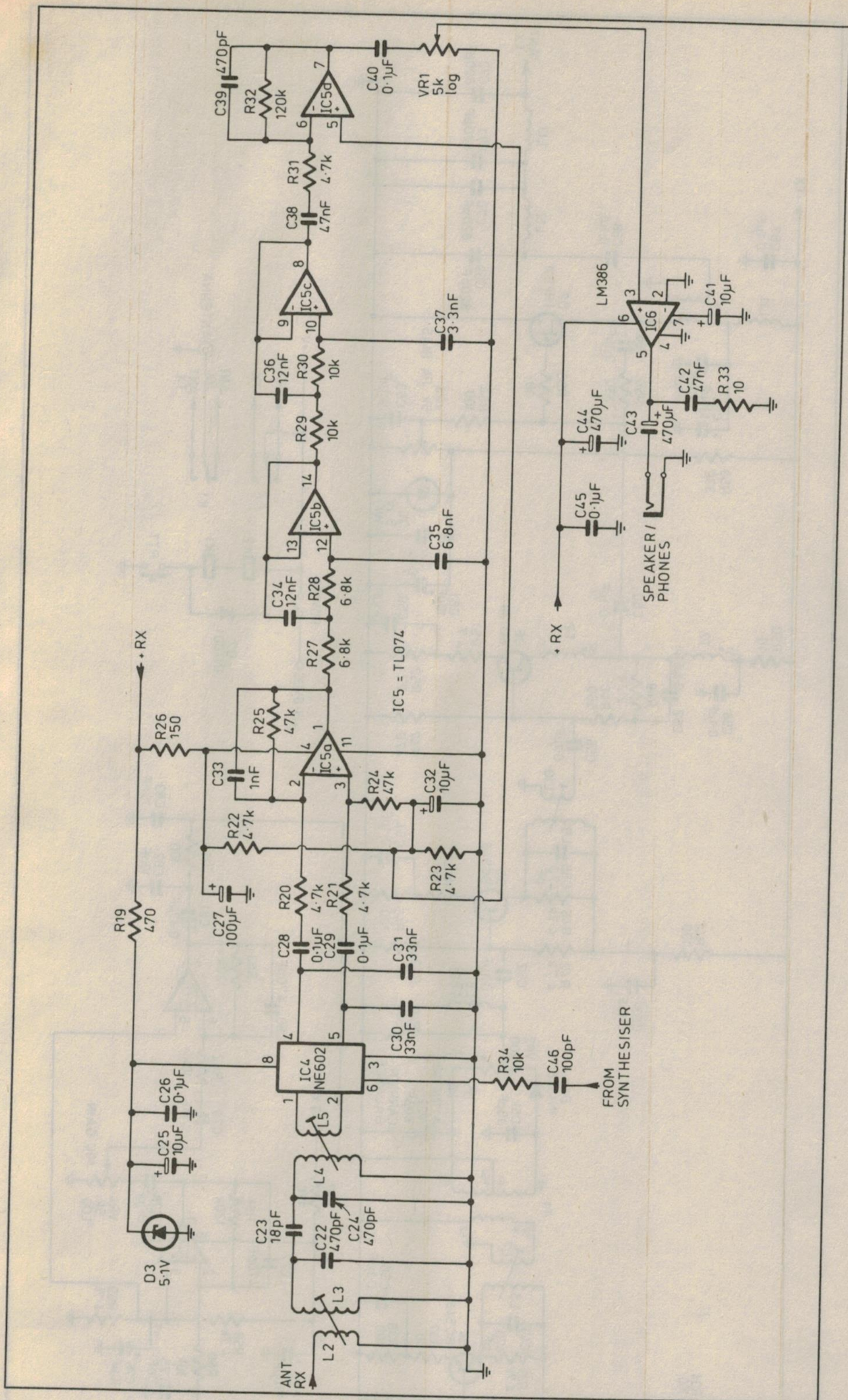



***Fig.5: The circuit schematic for the transceiver's receiver section, which uses only three ICs. Note the use of an NE602 balanced mixer chip (IC4).***

comes quite easy to do. To make it even easier a table of switch positions is included (Table 1).

Pin 16 of IC1 allows expansion of the frequency coverage. By grounding the pin the range is from 3520 to 3675kHz, while if the link is removed the range is from 3680 to 3835kHz. If the wider range is necessary, an extra switch can be added to the front panel.

IC1 receives 5V from IC3, and filtering is supplied by C9, C10 and C11. Pins 7 and 8 are the outputs from the PLL phase detector and pulse low when there is a phase difference on the inputs. When there is no phase difference the outputs are continually high. IC2 and associated capacitors and resistors form the low pass filter. The values were initially calculated using the data sheet, but were changed to the current values after trial and error. The loop locks quickly and doesn't seem to have any hidden problems.

The output from IC2 controls the frequency of the voltage controlled oscillator, which is formed around Q1. Variable capacitance diode D1 and coil L1 form the tuned circuit. C13 and C14 are the main feedback components and were selected for best waveform shape.

The oscillator power supply is regulated by an 8.2V zener diode D2, and filtered by C12 and C17, to prevent power rail fluctuations modulating the oscillator frequency.

The output of the VCO at the collector of Q1 is coupled to the buffer by C16. The values of C16 and R13 are chosen to lightly load the tuned circuit. The buffer is formed with Q2 and Q3, a well known and reliable circuit and provides a low output impedance signal with a peak to peak value of around 1V. The output of the buffer, as well as going to the main board is also capacitor coupled to the Fin input (pin 1) of IC1, via C21.

## Complete transceiver

The block diagram of the complete transceiver is shown in Fig.4. The relays are shown in the de-energised, or 'receive' condition. The signals from the antenna are coupled to a bandpass filter (BPF), which passes the wanted signals but greatly attenuates signals outside the 80m band.

From the BPF the signal is applied to the product detector. The other product detector input is from the frequency synthesiser. The resulting audio signals are then filtered to remove high frequency components by the audio low pass filter. The low level signals are then amplified and passed to the audio power amplifier via the volume control. The audio PA develops enough power to drive either an external speaker or headphones.

In the transmit mode, signals from the microphone are amplified and applied to the balanced modulator. The modulator also receives the carrier signal from the frequency synthesiser. The low level double-sideband suppressed carrier signal is then amplified by three stages, passed through a low pass filter to attenuate unwanted harmonics and then through the relay to the antenna.

Two relays are used; one switches the antenna and the other switches the positive power rail to the required circuits. Note that the frequency synthesiser runs all the time that power is applied.

# DSB transceiver - 1

## Receiver in detail

As noted earlier, the receiver is a direct conversion type, where the incoming signals from the antenna are mixed with a local oscillator signal of the same frequency as the wanted signal.

The result is that the signal is demodulated directly, and the audio signal appears at the output of the product detector. The receiver schematic is shown in Fig.5.

The signal from the antenna is link coupled to the first tuned circuit L3/C22, which is top coupled by C23 to the second tuned circuit L4/C24. This combination provides a flat response across the 80m band, together with high attenuation of out-of-band signals. The signal is then link coupled to the product detector, IC4.

An old favourite, the NE602 double-balanced mixer is used here, and the internal oscillator is not required. The signal from the frequency synthesiser is applied to pin 6, through attenuating components C46 and R34.

This provides about 300mV p-p at pin 6. A regulated 5V supply for IC4 is supplied by R19, D3, C25 and C26. IC4 has two differential outputs at pins 4 and 5. Using the two outputs in this manner improves the circuit stability and gain, as the levels at this point are quite small.

IC5a is configured as a differential amplifier, with a gain of 10. A half-Vcc or 'pseudo ground' point is formed by R22, R23 and C32. C30, C31 and C33 attenuate the high frequencies that will still be present at the output of IC4.

IC5b, IC5c and associated components form a four pole low-pass filter, with a corner frequency of around 2550Hz. The receiver's ability to reject adjacent signals is dependant to a great extent by the characteristics of this filter. IC5d amplifies the low level signals from the LPF, and C39 provides extra low pass filtering.

The signal then passes via the volume control to the audio power amplifier IC6, which provides enough level to drive an external speaker or headphones.

## Transmitter circuit

The circuit of the transmitter section is shown in Fig.6. Q4 amplifies the signal from the frequency synthesiser. R37 and R39 control the gain of the stage to a low stable value. R39 is also placed across the tuned circuit L6/C49 to increase the bandwidth, so that the response is relatively flat across the 80m band. This stage delivers about 20mW to the balanced modulator.

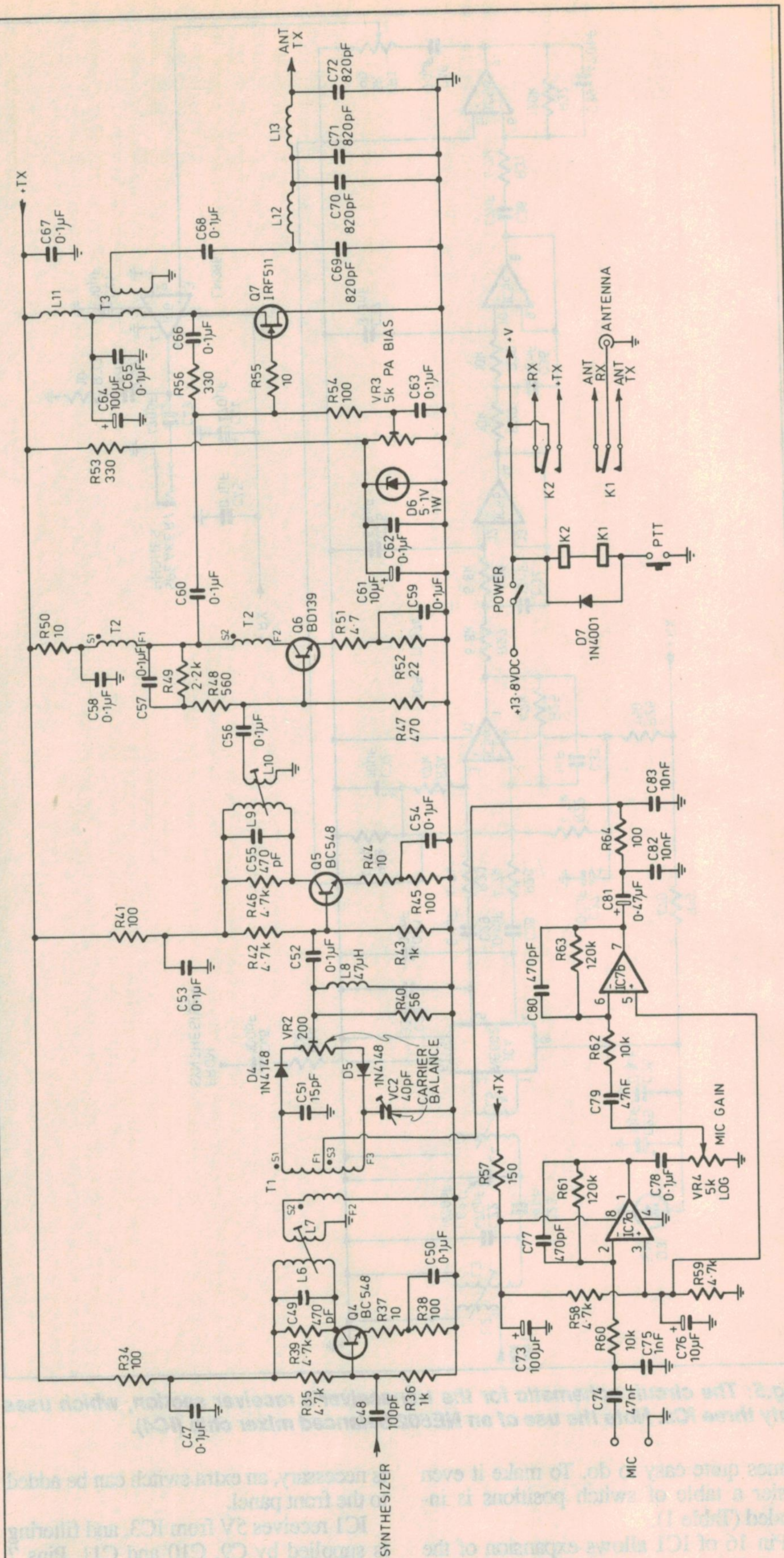



**Fig.6: And here is the schematic for the transmitter section, including the 'press to talk' receive/transmit switching. Power amp FET Q7 delivers between six and eight watts of PEP output to the antenna.**

## TABLE 1
## FREQUENCY SWITCH SETTING TABLE

| Frequency | 5 | 10 | 20 | 40 | 80 |
|---|---|---|---|---|---|
| 3520 | 0 | 0 | 0 | 0 | 0 |
| 3525 | 1 | 0 | 0 | 0 | 0 |
| 3530 | 0 | 1 | 0 | 0 | 0 |
| 3535 | 1 | 1 | 0 | 0 | 0 |
| 3540 | 0 | 0 | 1 | 0 | 0 |
| 3545 | 1 | 0 | 1 | 0 | 0 |
| 3550 | 0 | 1 | 1 | 0 | 0 |
| 3555 | 1 | 1 | 1 | 0 | 0 |
| 3560 | 0 | 0 | 0 | 1 | 0 |
| 3565 | 1 | 0 | 0 | 1 | 0 |
| 3570 | 0 | 1 | 0 | 1 | 0 |
| 3575 | 1 | 1 | 0 | 1 | 0 |
| 3580 | 0 | 0 | 1 | 1 | 0 |
| 3585 | 1 | 0 | 1 | 1 | 0 |
| 3590 | 0 | 1 | 1 | 1 | 0 |
| 3595 | 1 | 1 | 1 | 1 | 0 |
| 3600 | 0 | 0 | 0 | 0 | 1 |
| 3605 | 1 | 0 | 0 | 0 | 1 |
| 3610 | 0 | 1 | 0 | 0 | 1 |
| 3615 | 1 | 1 | 0 | 0 | 1 |
| 3620 | 0 | 0 | 1 | 0 | 1 |
| 3625 | 1 | 0 | 1 | 0 | 1 |
| 3630 | 0 | 1 | 1 | 0 | 1 |
| 3635 | 1 | 1 | 1 | 0 | 1 |
| 3640 | 0 | 0 | 0 | 1 | 1 |
| 3645 | 1 | 0 | 0 | 1 | 1 |
| 3650 | 0 | 1 | 0 | 1 | 1 |
| 3655 | 1 | 1 | 0 | 1 | 1 |
| 3660 | 0 | 0 | 1 | 1 | 1 |
| 3665 | 1 | 0 | 1 | 1 | 1 |
| 3670 | 0 | 1 | 1 | 1 | 1 |
| 3675 | 1 | 1 | 1 | 1 | 1 |

T1 and diodes D4 and D5 are the main components of the balanced modulator. The centre tap of T1 is grounded to RF by C83. Diodes D4 and D5 are switched on during the half cycle that S1 is positive and F3 is negative.

If the two diodes are identical, then there will be no output at the junction, as the two currents will be equal and opposite in phase and hence cancel out. During the half cycle that S1 is negative and F3 is positive, the diodes will be reversed biased and again there will be no output.

In reality the two diodes will not be identical and so VR2 is used to overcome the forward resistance difference and C51 and VC2 are used to balance the capacitance on each leg. As long as we don't unbalance the legs there will be no output.

In practice we cannot obtain a perfect balance, but with careful adjustment over 40dB of attenuation is possible.

IC7a and IC7b form the microphone amplifier. C75 is used to bypass any RF that may find its way onto the microphone lead. C77 and C80 provide low pass filtering of the audio signal.

Unlike a SSB transmitter, there isn't a sharp filter to limit the bandwidth of the transmitted signal. In a DSB transmitter we must make sure that we restrict the bandwidth in the audio stages.

The amplified microphone signal is fed to the centre tap of T1 by C81 and R64. When an audio signal is applied to the centre tap, it unbalances the modulator legs by causing extra current to pass through either D4 or D5, depending on the instantaneous polarity of the audio signal.

The resulting waveform at the wiper of VR2 is a double-sideband suppressed carrier signal. R40 provides a wideband termination for the modulator and L8 provides a low impedance return path for the audio signal, but a high impedance to the RF signal. The low level signal of around 1mW maximum is amplified by Q5 and this stage is identical to Q4.

Q6 is a broadband amplifier, using a bifilar winding in the collector. This stage draws about 50mA and is capable of providing about 200mW to the final stage. Heavy feedback is used, providing predictable and stable performance. R54 is the load for Q6, and the voltage developed across it is used to drive the final stage Q7.

Q7 is a power FET, and like all FETs is a voltage driven device. This is unlike bipolar transistors, which are current driven. Power FETs have a fairly linear transfer function after the gate voltage exceeds a few volts.

Here the gate is biased just into the linear region by the voltage from VR3. Zener diode D6 and its associated components provide a stabilised voltage for the bias circuit. R55, R56 and C66 are used as a precaution against instability.

T3 couples the drain signal to the output low-pass filter. L11, C64 and C65 prevent RF appearing on the supply rail. This circuit has proved to be very successful, and has survived a lot of abuse during the prototyping stages. The output filter is used to attenuate out of band signals that may be produced in the amplifier stages.

Two relays are used to switch the antenna and the power rail between the receiver and transmitter circuits. The relays are energised and placed in the transmit mode when the microphone's 'push to talk' (PTT) switch is operated. D7 protects the circuits from voltage spikes as the relay coils energise and de-energise.

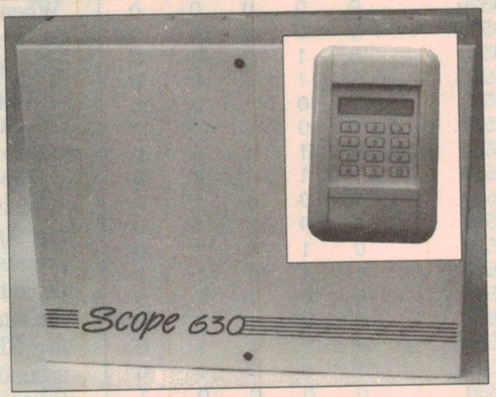
That completes this first article describing the new DSB transceiver, and hopefully you now have a good idea of the way it works.

In the second article we will describe its construction and adjustment.

*(To be continued)* ❖

# JAYCAR SPECIALS FOR MAY

## SCOPE 12 SECTOR HOUSE ALARM BARGAIN




Ideal for warehouses, factories and large houses. Incorporates 12 sectors plus 5 tamper zones. It is fully programmable and is supplied with a 114 page installation/service manual/operating instructions. The unit is in a metal box measuring 355(W) x 290(H) x 120(D)mm which can be hidden away in a cupboard or attic. The alarm is controlled by a separate digital keypad with an alpha numeric LCD display. One keypad is supplied. Programming features include: • permanent memory hold up facility • separate timed exit, entry and PA circuits • any zone can be timed (0-99 secs) as an exit/entry • final door set • digital communicator outputs, arm/disarm, alarm, personal attack, fire/tamper • these can be inverted • hand over zones, programmable on any zone • isolate facility (except PA, fire and tampers) • soak test (on any zone) • operator memory stores 8 events • siren test, piezo • zone paring • key terminal • 6 options • automatic reset - 10 options • end of line resistors programmable on any alarm zones • pulse count on all zones.

Specifications:

| | |
|---|---|
| Operating Voltage | 16 - 18V AC |
| Operating Current | 150mA |
| End Line Resistor | 1k |
| Current De-bounce Time | 200m sec |
| Output Voltage | 13.65V DC |
| Memory Type | EPROM programmed through keypad |
| Keypads | LCD with alpha numeric characters |

Plug pack to suit 16V AC Cat. MP-3021 $22.50
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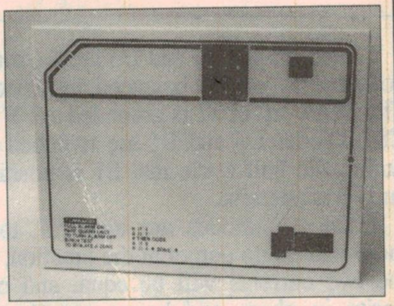
This alarm has a digital 7 segment display on the panel to show sector conditions and system information. There is also a 12 digit keypad on the front.



Specifications:

| | |
|---|---|
| Operating Voltage | 16-18V AC |
| Output Voltage | 13.6V DC |
| Standby Battery | up to 6.5Ah |
| Sector De-bounce Time | 300m sec |
| Entry Time | prog 0-99 secs |
| Siren Time | prog 1 - 10 min |
| Quiescent Current Consumption | 125mA |
| Power Output Max Current | 1A DC |
| No of Sectors | 6 x burglary |
| Size | control box 330 x 255 x 82mm |

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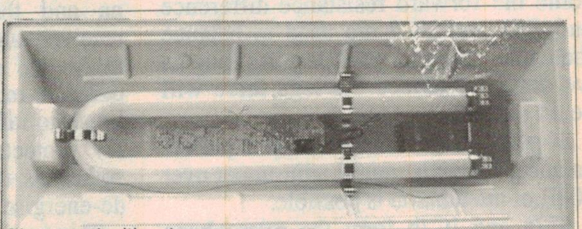
Illustrated without perspex cover

Another surplus stock purchase. Limited quantity - grab one while they last.
This unit was designed for use as an illuminated flashing sign, probably for cars. It looks a bit like the signs you see on taxis. It incorporates a 40 watt U-shaped flourescent tube (supplied) and it's housed in a white plastic case - size 760 x 305mm with an opaque white perspex cover. It has a dual timer - one to delay operation between 1 and 4 hours, and the other to control the duration of operation between 1 and 4 hours. There is also a reset switch which halts the flashing, so could be shorted out to stop the flashing totally.
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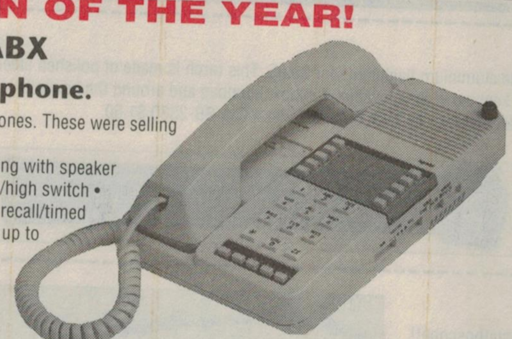
Priced less than a basic telephone. Ideal for hearing impaired people, as it has a light which illuminates when the phone rings. Outstanding value. Plugs directly into your home wall socket.



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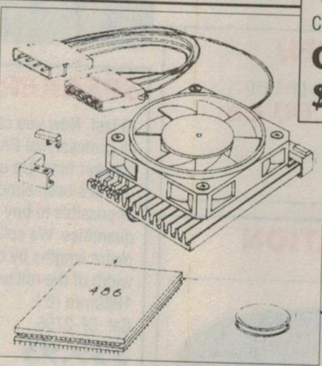


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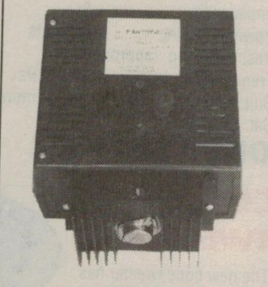

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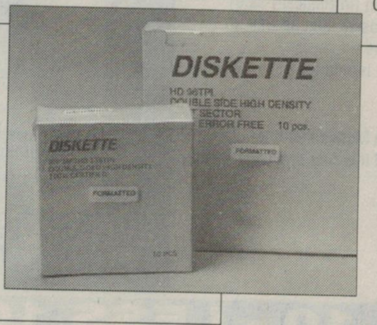


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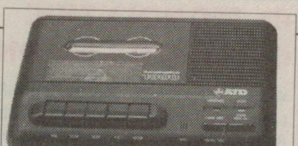

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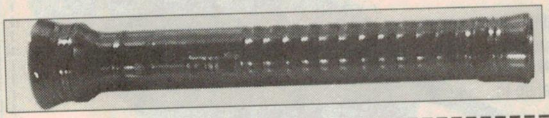
We have sold thousands of machined aircraft grade aluminium flashlights for $9.95. This torch is made of polished steel and gives out a very reasonable light. It's ideal for keeping in the glovebox, toolbox, handbag and around the house in case of emergencies. And at $2 you can certainly afford to. Uses 2 AA batteries. Pkt 4 Cat. SB-2330 $1.60.

Cat. ST-3010 **ONLY $2 each**

**BARGAIN** NEW FOR '93



## STETHOSCOPE

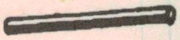
Yes, that's right, Jaycar now stocks a high quality stethoscope!! Its acoustic response is remarkable. Unlimited uses, listen to your heart!! Use with our blood pressure meter, even listen for nasty knocks in your cars engine. Japanese made.

Cat. QM-7255 **$19.95**

## FERRITE ROD REDUCED

New size 100mm long x 9mm diameter. Cat. LF-1010

**NEW LOW PRICE $1.00 ea**



## 10" WOOFER SENSATION

This is a quality woofer with foam roll surround, silver dust cover and grey ribbed cardboard cone. Listed below are all the specifications we have available.

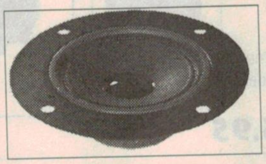
| | |
|---|---|
| Impedance | 8Ω |
| Power Handling | 60 watts |
| Resonant Freq. (approx) | 38Hz |
| Frequency Response | 38 - 3kHz |
| Suitable Enclosure | 25L or more - sealed |

NEW FOR '93

Cat. CW-2117

**ONLY $20 ea**

## CONE TWEETER



The new cone tweeter has a black cone with plastic dust cover. It is designed to be mounted from the front of the cabinet. Ideal replacement tweeter, or for general use.

| | |
|---|---|
| Impedance | 8Ω |
| Power Handling | 75 watts system power |
| Frequency Range | 3000 - 16kHz |
| SPL | 91.5dB - 2dB/W |

NEW FOR '93

Cat. CT-2002

**$7.95**

## RT MONOLYTHIC CAPACITOR MADNESS

NEW FOR '93

We've made a scoop purchase of 0.1µF 50V RT Monolythic capacitors. They are made by Centralab, which is a North American Philips company. Normal style 0.1µF monos cost 25¢ each or $16.50 pkt 100.

Cat. RC-5497

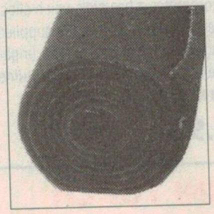
**SAVE A FORTUNE WITH THESE ONLY $5 per pkt of 100**

## SPEAKER CARPET

At last. Now you can buy the black carpet that is on all professional PA speaker bins. Up until now it's been almost impossible to buy small quantities. We sell it in 1 metre lengths by the width of the roll which is 1860mm (6').

Cat. CF-2755

**$39.95**



## UPGRADE YOUR MIDRANGE

Quality white cone. See catalogue. Power handling 80W RMS system. Frequency response 350 - 5.5kHz.

Cat. CM-2080

**NORMALLY $28.50**

**MAY $20 SAVE $8.50**

## MOTOROLA J FET BARGAIN

Type J309. Package TO-92, high frequency N-channel J FET.

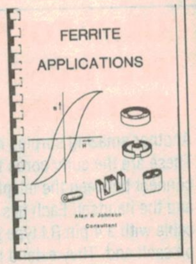
Brief specs: ReVts (mmho) min -12+, f (MHz) 100, ReYos (µmho) max 250+, f (MHz) 100, Clas (pF) max 7.5, Cres (pF) max 2.5, HF (dB) max 1.5+, RG=1k f (MHz) 100, (V) min 25.

Cat. ZT-2380

**WORTH OVER $3 ea**

**pkt 50 for $10**

## FERRITE MATERIAL & APPLICATIONS BOOK




This is one subject that is very difficult to find any information on. Magnetic cores are the foundation for transformers, inductors and chokes used in so many of our electronic projects. This book is intended to be used by persons who want to (or have to) work with ferrite materials, but are not well versed in magnetics or ferrites and cannot justify outside consultation. Some of the problems addressed are:- • How to select the right type of material • How to identify an unknown material • How to measure material properties and much more. Written in 1991 by A. K. Johnson.

Softcover, ringbinder. 82 pages 212 x 132mm.

Cat. BC-1125 **$18.95**

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## WHAT A FLOP!

## 'LIFE-GUARD' PETROL VAPOUR DETECTORS

**Model UA-2A** This unit consists of cold sensor detector (which is situated in the bilge) wiring loom and control unit/alarm. It has an on-off test switch alarm buzzer and light. Both light and buzzer go off when fume concentration is still well below (20%) explosive level. The unit also includes a testing gas spray pack.

Cat. LA-5270 **WAS SELLING FOR $39.95 NOW $15**

**Model GVM-50** This unit is permanently wired into your boat and does not contain a test switch. Its operation is automatic. It consists of an attractive circular transducer, cold sensor and testing gas.

Exclusive Cold Sensor Features

- Detects gas instantly (no warm up)
- Does not burn vapour for detection (intrinsically safe)
- Detects gas above the upper explosive limit as well
- Longest sensor life of popular type
- Unaffected by salt water and high humidity
- Can detect rapid build-up as well
- Detects high bilge water
- Endorsed by prestigious Swedish Metals Institute
- Normally closed alarm will sound if wiring broken (fail safe)

Cat. LA-5272

**WAS SELLING FOR $24.95 NOW $10**


**BUY 10 - LESS 10%**

Construction Project:

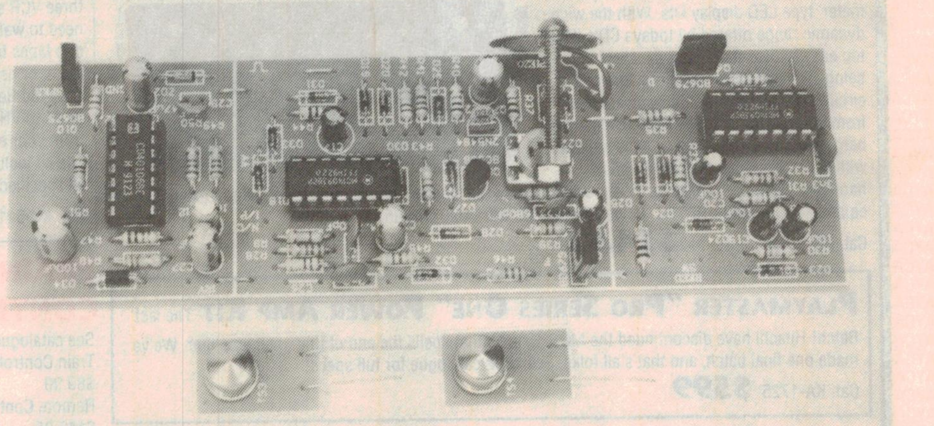
# 'Protect Anything' Alarm Module

**Here's an alarm to suit almost any purpose. Use it to protect almost anything that moves — from cars or pushbikes to pool gates. It has many features, including a reed switch to enable or disable the alarm, two types of sensors and your choice of siren. It's multipurpose, simple to build and a kit costs less than $25.**

**by PETER PHILLIPS**

This project comes from Oatley Electronics, and embodies their philosophy of maximum flexibility with a low cost. The whole unit is in three integrated sections, giving a range of choices so you can tailor the alarm to whatever purpose.

Alarms of all shapes and sizes have featured in *EA* many times, although most have been either dedicated house or car alarms. This alarm offers a flexibility that, to the best of our knowledge, has not been described before. Here's a few possibilities that suit this project...



You borrow someone's trailer, and because you can't fit it in the garage, it has to remain outside. To protect it against theft, simply place this alarm in the trailer; if someone tries to move the trailer the alarm will sound. When the trailer is returned to its owner, take the alarm out and use it somewhere else.

Perhaps you want to protect a pushbike, just for those times when you need to prop it outside a shop. Leave the alarm attached to the bike, perhaps inside a bag, and rest easy while you shop. Of course, the alarm is ideally suited for permanent installation on a pushbike or a motor bike.

Maybe you want to know if someone is rifling through your files, or having midnight snacks from the 'fridge. This alarm will soon tell you! Another instance might be to give a warning if the gate to the pool is opened, or if a door or a window is opened.

Because the unit is compact and battery powered, if an item is movable, this alarm can protect it. The circuit draws a negligible current from the battery while in standby mode, and can be powered from a 9V battery, a 6V battery pack, even a 12V source. The possibilities are almost endless, made so by the flexibility designed into this project. Here's some of the features...

## Three sections

The whole project has three individual sections, and you can use each section on its own or integrated with others. The PCB can therefore be cut to separate each section, or left as a complete unit. The three main sections are a reed switch operated electronic switch, the alarm section and a siren driver.

The PCB also has another section to support the movement sensors. This part can be left attached, or cut off if you want to place the sensors away from the rest of the unit.The electronic switch allows the alarm to be enabled or disabled with a reed switch and magnet, or even a hidden pushbutton. This gets around the expense of a key-operated switch and gives added versatility. If you use a reed switch, simply place a magnet near the reed switch to toggle the electronic switch on or off.

This circuit also has an output stage so you can monitor the status of the switch. The output can be used to drive a lamp, (LED, incandescent, even blinkers in a car), or it can be connected to a separate buzzer or to the main siren.

It pulses on for about three seconds when the switch is operated to enable the alarm. A much shorter pulse is delivered when the alarm is disabled.

The alarm section is based on a proven bike alarm designed some years ago by Oatley Electronics. It has a five second entry delay, and times out after 45 seconds or so. However, unlike the previous design, this one has additional movement sensors.

Referred to as 'tilt' sensors, these devices are specially designed to respond to a shift in their orientation. For instance, if you enable the alarm when the sensors are at 20° from the horizontal, a slight movement away from this will trigger the alarm.

The sensors consist of a ball inside a metal enclosure that has a number of contacts. If the ball moves, it will cause

a make and break sequence during the movement, enough to trigger the alarm. Two sensors are included in the kit, making the unit extremely sensitive.

As in the previous design, there is also a piezo device to detect bumps or sudden shocks that might not be detected by the tilt sensors.

The alarm can directly operate a piezo siren, or it can be connected to the next section: a siren driver. The siren driver lets you use a conventional 8-ohm speaker as the output transducer. The circuit produces a loud, high pitched siren sound (rather like a police siren), even from a small 250mW speaker.

There are many options on how you build the unit. It can be installed as a permanent alarm, perhaps on a bike, a boat or similar; or it can be built in a free-standing box and used as a temporary alarm.

There are other features to allow the project to be used as part of an existing alarm. Of course you might use the siren driver with another alarm, and use a piezo siren with this one. In other words, you can 'mix and match' as you need.

And you'll probably see many other variations and uses for the alarm, as we describe the circuit.

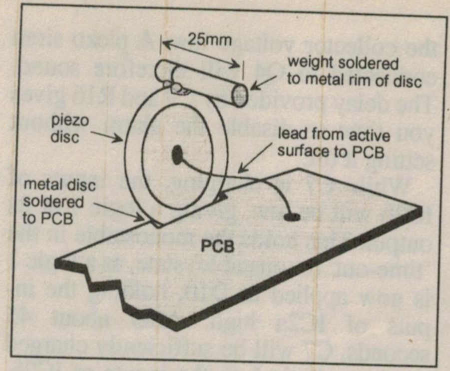



***Fig.2: Here's how the piezo disc is fitted. Don't apply the soldering iron directly to the disc surface — tin the wire lead first and apply heat to it while holding it against the disc.***

## The circuit

The circuit is shown in Fig.1, and as already explained, has three sections. We'll start with the electronic 'on-off' switch, which is the circuitry around IC1.

A toggle flipflop is formed by IC1c and IC1d and their associated components. When power is first applied, all capacitors are discharged, and C1 holds the inputs of IC1d low, causing its output to switch high.

This will charge C2 via R3, and also give a logic 1 to the inputs of IC1c. The output of IC1c will therefore be low, and because it's coupled back to the inputs of IC1d, the flipflop is held in this state. The output at point A is therefore a low, the required logic level to enable the alarm section.

While C2 is charging, a logic 1 will appear across R3, coupled via D2 to the inputs of IC1b. The output of this gate will therefore be low, and this is inverted by IC1a to give a high output which turns on Q1. A visual or audible indication will be given if a load (lamp or buzzer) is connected from the 12V rail to the collector of Q1.

When C2 is charged, the input to IC1b will return to a low, held in this condition by R5. The time taken for C2 to charge is determined by the values of C2 and R3, which for the values shown is around three seconds. Therefore, Q1 is on for this time only.

The reed switch is normally open, and closes when a magnet is placed near the switch. When this happens, C1 is connected to the inputs of IC1c, bringing them low. The output of IC1c switches high, and because its output is coupled back to the inputs of IC1d, the flipflop

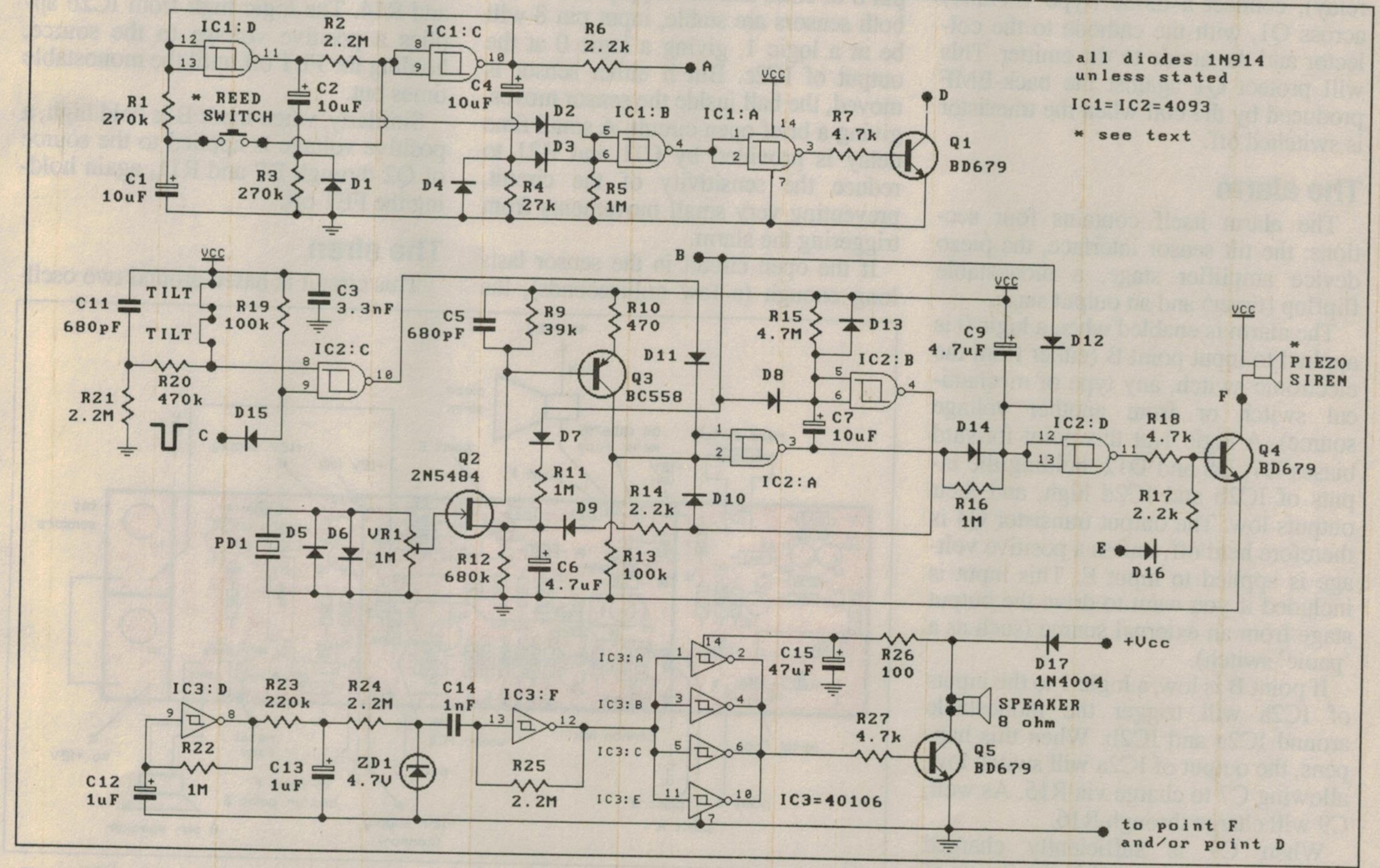



***Fig.1: The circuit has three sections — the electronic switch around IC1, the alarm section and the siren around IC3. The alarm itself has two types of sensors, a timer around IC2a and b, and an output transistor driven by IC2d.***

now remains in the new state, giving a high at output B. This disables the alarm.

A normally-open pushbutton, key-operated switch or a conventional toggle switch can be used instead of the reed switch. Naturally, you'd need to hide these from view.

When the output of IC1c goes high, C4 charges via R4, giving a logic 1 to the inputs of IC1b. This causes Q1 to turn on, for a duration determined by the values of C4 and R4. Because their time constant is less than that of C2 and R3, Q1 will operate for a shorter time. So a long pulse at Q1 indicates that output A is at a logic 0, (the alarm is enabled) and a short pulse lets you know that point A is a logic 1.

Transistor Q1 can pass a current of 1A or more, and can be used to drive a range of loads. For instance, you could connect a buzzer, a lamp or the blinker relay of a vehicle. As later explained, it can also be used to switch the siren section on and off. However, the transistor is not large enough to directly power car blinkers — only the relay used to drive them.

If you use an inductive load (like a relay), connect a diode (type 1N4004) across Q1, with the cathode to the collector and the anode to the emitter. This will protect Q1 against the back-EMF produced by the coil when the transistor is switched off.

## The alarm

The alarm itself contains four sections: the tilt sensor interface, the piezo device amplifier stage, a monostable flipflop (timer) and an output stage.

The alarm is enabled when a logic 0 is applied to input point B (either from the electronic switch, any type of mechanical switch or from another voltage source). A logic 1 at this point forward biases D7, D8 and D12, holding the inputs of IC2b and IC2d high, and their outputs low. The output transistor Q4 is therefore held off, unless a positive voltage is applied to input E. This input is included if you want to drive the output stage from an external source (such as a 'panic' switch).

If point B is low, a logic 1 to the inputs of IC2a will trigger the monostable around IC2a and IC2b. When this happens, the output of IC2a will switch low, allowing C7 to charge via R15. As well, C9 will charge through R16.

When C9 is sufficiently charged (after about five seconds), the inputs of IC2d will be at a logic 0, sending its output high. This turns on Q4, making the collector voltage low. A piezo siren connected to Q4 will therefore sound. The delay provided by C9 and R16 gives you time to disable the alarm without setting it off.

While C7 is charging, the inputs of IC2b will be low, giving a logic 1 at its output. This holds the monostable in the 'time-out' (or unstable) state, as a logic 1 is now applied to D10, holding the inputs of IC2a high. After about 45 seconds, C7 will be sufficiently charged to give a logic 1 to the inputs of IC2b, sending its output low and reverse biasing D10. The inputs of IC2a are now returned to a logic 0 by R13. The output of IC2a then switches high, forward biasing D14 and giving a logic 1 to the inputs of IC2d. Its output becomes a low, and Q4 turns off.

Therefore, the values of R15 and C7 determine how long the alarm sounds when it's triggered. Reducing the value of either reduces the 'on' time of the alarm, and conversely increasing either gives a longer time. The entry delay time can also be modified by changing the values of C9 and R16.

The tilt sensor interface is around IC2c. As shown in the circuit, two tilt sensors are connected in series between pin 8 of IC2c and the supply rail. When both sensors are stable, input pin 8 will be at a logic 1, giving a logic 0 at the output of IC2c. But if either sensor is moved, the ball inside the sensor moves, giving a brief open circuit. A small time delay is provided by C11 and R21 to reduce the sensitivity of the circuit, preventing very small movements from triggering the alarm.

If the open circuit in the sensor lasts long enough (a few milliseconds), the output of IC2c will pulse high. Isolating diode D11 will be forward biased and the positive pulse then triggers the main alarm monostable to its unstable state.

Input C is an external input that can be connected to another type of sensor — for example a reed switch or any sensor that gives a logic low when operated.

The piezo sensor section is that associated with FET Q2 and transistor Q3. The resonance of the piezo disc PD1 is about 70Hz, because of the brass weight attached to the disc. When a shock causes the disc to move, it will produce a voltage that is clipped to +/-0.7V by diodes D5 and D6. The voltage developed across VR1 is then applied to Q2. The setting of VR1 determines the sensitivity of the piezo sensor.

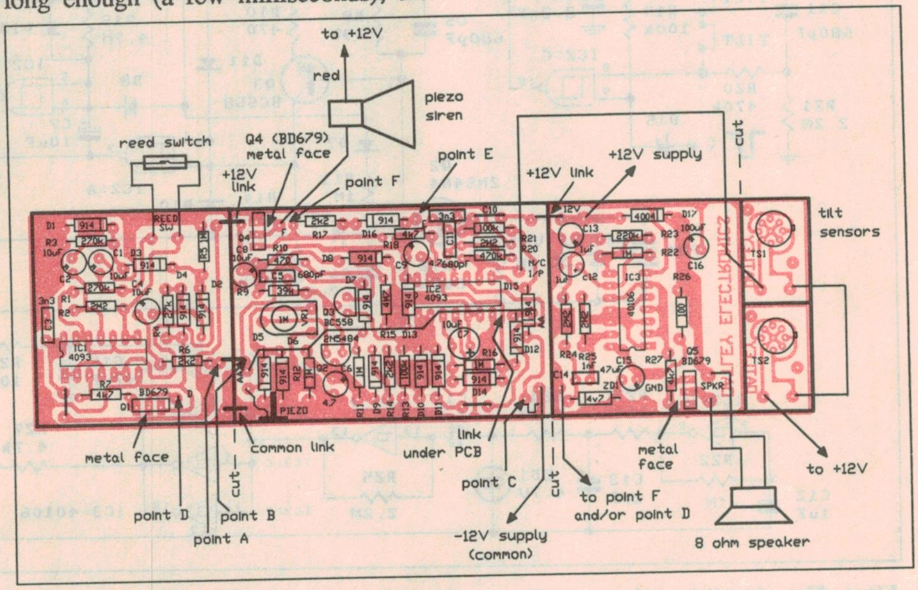
The FET is biased to almost cutoff by R12. Notice that this resistor has a value of 680k, which is much higher than you'd expect in a FET amplifier. This trick ensures that a small positive voltage at the gate of the FET makes it conduct. When this happens Q3 also turns on, giving a positive input to IC2a and again triggering the monostable into its unstable state.

To prevent re-triggering during the timing cycle, the output of IC2b is connected back to the source of Q2 via D9 and R14. The logic high from IC2b applies a positive voltage to the source, holding the FET off until the monostable times out.

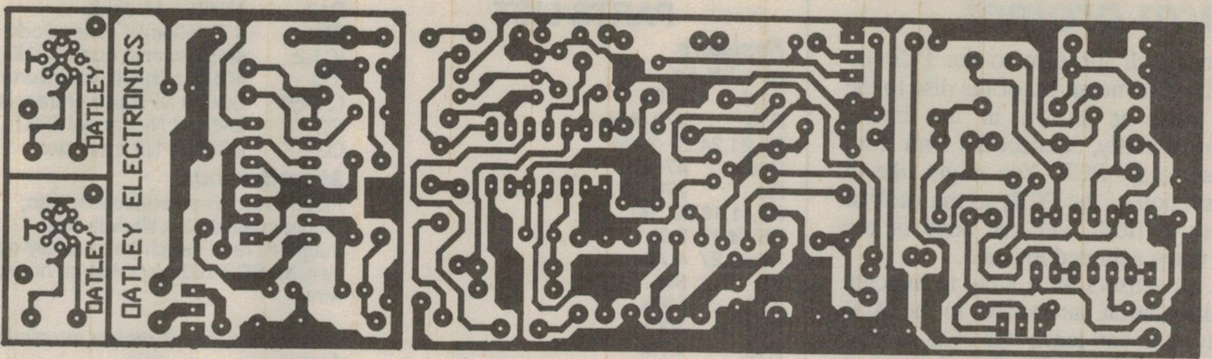
Similarly, when input B is held high, a positive voltage is applied to the source of Q2 through D7 and R11, again holding the FET off.

## The siren

This circuit is based around two oscil-




***The layout for the PCB. The orientation of the power transistors is shown here, along with the various connection points.***




***Here is the PCB layout, if you want to make your own. The design is copyright to Oatley Electronics, but individuals can use it for non-commercial purposes. Screen-printed boards are also available from Oatley Electronics.***

lators, which together produce a very penetrating sound. The first oscillator is formed by IC3d, R22 and C12 and has an operating frequency of about 1Hz. The second oscillator is around IC3f, with its operating frequency set by R25 and C14. This oscillator is modulated by the first.

The output of the first oscillator is connected to the second via the smoothing network consisting of R23 and C13. The voltage developed across C13 is then limited by ZD1 and R24. The coupling network therefore gives a 1Hz modulating signal to the second oscillator that is roughly sinusoidal, varying from 4.7V to -0.6V. This signal causes the second oscillator to vary in frequency from 500Hz to about 4kHz.

The output of the second oscillator is buffered by the parallel connected inverters IC3a, b, c and e, which drive Q5 via R27. The speaker is driven directly by the transistor, and even a low power speaker will produce a very high sound level.

The IC used in the siren circuit (IC3) is a Schmitt input hex inverter, and the hysteresis of the IC affects the sound produced by the circuit. While most varieties of this IC will work, the best sound is produced by those made by Philips. This type will be supplied in the kit.

Power to IC3 is supplied through R26, filtered by C15. Diode D17 prevents damage to the circuit if the power supply polarity is wrong. If an 8-ohm speaker is connected as shown in the circuit diagram, the siren will take about 0.4A when powered from a 12V supply.

A lower current consumption will result if a higher impedance speaker (33 ohms) is used. A current as low as 50mA is taken if a speaker transformer is used, with no reduction in the sound output. Oatley Electronics have a suitable transformer, available for $1.

## Interconnections

Because the output transistor (Q4) of the alarm section is a high current device, power to the siren PCB can be switched by this transistor. In this case, the negative (common) line of the siren PCB connects to point F. Naturally, you wouldn't need the piezo siren.

As well, the siren PCB can be switched by the electronic switch to allow the siren to serve as an indicator when the alarm is enabled or disabled. Again the common line of the siren PCB is connected to the collector of Q1 (point D). Therefore if you are using all three sections, the collectors of Q1 and Q4 are both connected to the common of the siren PCB. Because of the open-collector configuration there is no conflict, and the siren will sound when either transistor is turned on.

The only other interconnection is a link between points A and B, so the electronic switch can enable or disable the alarm. Of course each section requires a power source, and links are provided on the PCB to allow a single connection to the supply.

## Construction

As explained already, the PCB for this project contains four independent sections. These can be separated, or the PCB left intact. Obviously you should cut the PCB (if required) before any components are fitted.

If you buy a kit (see details at end of article), you'll get a screen-printed PCB with the location of each component clearly shown. If you make your own, refer to the layout diagram for the placement of the components.

The sensors are fitted last, and as usual it's best to start with the low-profile components such as resistors, diodes and links. The number of links will depend on the interconnections you want between the PCB sections, and these are shown on the layout diagram. Note that a link is required on the track side of the board, between the points marked as AA. Check the polarity of the diodes before soldering them, as there are quite a few. Also, make sure you use a 1N4004 type (i.e., a 1A diode) for D17. All others are small signal types.

The capacitors can be fitted next, again making sure the electrolytics are fitted with the right polarity. Follow by fitting the transistors, which are orientated as shown in the layout diagram. Notice particularly how the power transistors are mounted, with the metal side facing as shown in the diagram.

The ICs (or sockets if you wish) can now be soldered in place. Again make sure of their orientation. Then, before fitting the sensors, check your soldering for any errors.

## Fitting the sensors

The piezo disc needs to be fitted with a brass weight to lower its resonant frequency. The weight can be a brass screw (25mm by 2.5mm) with two nuts locked together at the end of the screw, or it can be a piece of brass rod of similar dimensions.

As shown in Fig.2, the weight is soldered to the metal rim of the disc. The metal side of the disc faces out, and the weight extends over the PCB, soldered to the top of the disc.

Once the weight is fitted, solder a short length (about 20mm) of flexible hook-up wire to the active surface of the disc. To do this, first tin the wire and then lay it against the disc surface somewhere in the centre of the disc.

Without letting the soldering iron contact the disc, apply heat to the wire. Because it contains silver, the wire will solder easily to the surface. Soldering the surface directly can cause damage, so take care.

Then attach the disc to the PCB by soldering the metal rim of the disc to the earth track as shown in the layout diagram. Finally, connect the lead from the disc to the PCB. You might like to file a section of the PCB, so the back of the disc is flush with the edge of the board when soldered in place.

The tilt sensors have a tag to indicate their orientation, and solder to the PCB directly. You can leave this PCB section attached to the rest of the board, or cut it off and fit it remotely. You would cut the board off if the main PCB is to be mounted vertically, or at an angle that might cause the ball inside the sensor to sit away from the internal contacts.

The tilt sensors are connected in series from the supply to the alarm PCB input. Of course, one or both sensors can be used.

After the boards are completed, connect the reed switch (or other on-off switch) and loudspeaker. Also connect the power leads. At this stage, it's probably better to leave the sections electrically independent until they're tested. Also, leave the piezo siren disconnected until you've tested the alarm section.

## Testing

The circuit is designed to operate with a 9V supply, but the alarm and the electronic switch will operate at voltages from 6V to 12V. The siren will probably require at least 9V.

When power is applied to the electronic switch, output A should switch to a low and Q1 should pulse on for about three seconds. You can test this by connecting a suitable low voltage lamp from the supply to point D, and confirm that the lamp lights when the power is switched on. The lamp should then go out after the three second interval. Also, check that point A is at a voltage close to zero.

If you move a magnet close to the reed switch, point A should switch to a voltage nearly equal to the supply voltage and the test lamp should operate for about one second.

If this section is working, connect the link from A to B so the alarm can be enabled and disabled with the switch. To avoid waking the household, you might want to leave the piezo siren disconnected and connect a link from point F to point D. This allows the test lamp to serve as an indicator of both the switch and the alarm sections.

When power is first applied, the electronic switch will enable the alarm.

## PARTS LIST

### Resistors

All 1/4W, 5%

| | |
|---|---|
| R1,3 | 270k |
| R10 | 470 ohm |
| R2,21,24,25 | 2.2M |
| R20 | 470k |
| R4 | 27k |
| R5,11,16,22 | 1M |
| R6,14,17 | 2.2k |
| R7,18,27 | 4.7k |
| R9 | 39k |
| R12 | 680k |
| R13,19 | 100k |
| R15 | 4.7M |
| R23 | 220k |
| R26 | 100 ohm |
| VR1 | 1M PCB mount potentiometer |

### Capacitors

| | |
|---|---|
| C1,2,4,7 | 10uF 16V electrolytic |
| C3 | 3.3nF ceramic |
| C5,11 | 680pF ceramic |
| C6,9 | 4.7uF 16V electrolytic |
| C12,13 | 1uF 16V electrolytic |
| C14 | 1nF ceramic |
| C15 | 47uF 16V electrolytic |

### Semiconductors

| | |
|---|---|
| D1-16 | 1N914 signal diode |
| D17 | 1N4004 1A diode |
| ZD1 | 4.7V 500mW zener diode |
| IC1,2 | 4093 Schmitt quad NAND |
| IC3 | 40106 Schmitt hex inverter |
| Q1,4,5 | BD679 NPN power transistor |
| Q2 | 2N5484 N-channel JFET |
| Q3 | BC558 PNP transistor |

### Miscellaneous

Piezo siren; piezo transducer disc; 8-ohm speaker; 2 x tilt switches; magnetic reed switch (or normally-open switch); PCB 165mm x 45mm; hookup wire.

*Kits of parts for this project are available from:*
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.
Full kit, includes PCB and all components .............................. $24.90
8 ohm speaker. ........................... $2.50
Piezo siren ................................ $6.00
Partial kit, includes PCB, tilt switches, piezo disc only......... $12.00
Post and pack charges ................ $4.00

The alarm will probably also operate, after about five seconds. Disable the alarm with the reed switch, then enable it again.

Try the sensors by applying a small knock near the alarm PCB. This should trigger the alarm via the piezo disc. Experiment with the sensitivity adjustment to get the most reliable operation, without false triggers due to very small knocks.

Then try bumping the tilt sensors to trigger the alarm. In both cases, the alarm should come on after about five seconds and remain on for around 45 to 60 seconds. The tilt sensors are quite sensitive and only require a very small amount of movement to set the alarm off.

The siren PCB has no inputs and should make a characteristic siren sound when power is applied. As already explained, this section can be integrated to the alarm by connecting its common line to point F on the alarm board (which might also be connected to point D on the switch PCB).

If all is well, remove the test lamp and either connect the siren PCB to the alarm PCB or connect a piezo siren in its place. The piezo siren is polarised. The red lead goes to the supply voltage and the black lead to point F.

If you are using a piezo siren, you should find the total current taken by the unit (without the siren PCB) to be around 100mA when the piezo siren is operating. Otherwise, the current is negligible. For a 9V supply, expect a current (when alarm is triggered) of about 75mA, and around 40mA for a 6V supply.

## Using the alarm

As you can see, there are many possibilities with this alarm. For general use, simply place the board in a suitable box and power it with a 9V battery. If you are using the siren, you'll need to either fit a high impedance speaker or use a speaker transformer (such as Dick Smith type M-0216) to lower the current consumption.

The reed switch can be glued to the inside of the case (assuming a plastic box). A typical bar magnet should be able to operate the reed switch from a distance of 5mm or so. If you want to use it as a pushbike alarm, you might be able to place the electronics in a drink container attached to the bike frame. The reed switch could be placed under the bike seat.

As we've explained there are additional inputs to the alarm, so you can connect it to other sensors, perhaps from an existing alarm system. If a 12V supply is available, (such as in a car or a house alarm), use the siren PCB as it can produce a higher level of sound than a piezo siren.

In this case, because the current consumption is not a problem, connect the speaker as shown in the circuit. The bigger the speaker the better, but a small speaker (50mm diameter) will still produce a surprisingly loud noise.

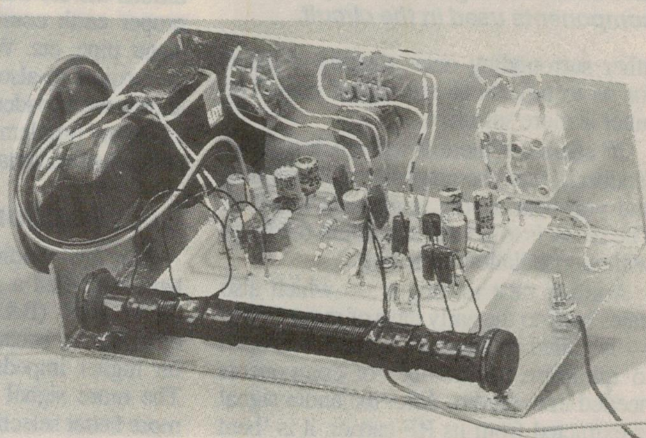
No doubt you'll think of many applications, as the unit is very sensitive. Truly an alarm for all purposes! ❖

# Experimenting with Electronics

by PETER MURTAGH

## *Regeneration/reflex radio*

Why build an AM radio when you can buy one so cheaply these days? It only makes sense if you want to understand how one works! So for those of you with an enquiring mind, here's how to get good reception with a design that has been around for a long time.

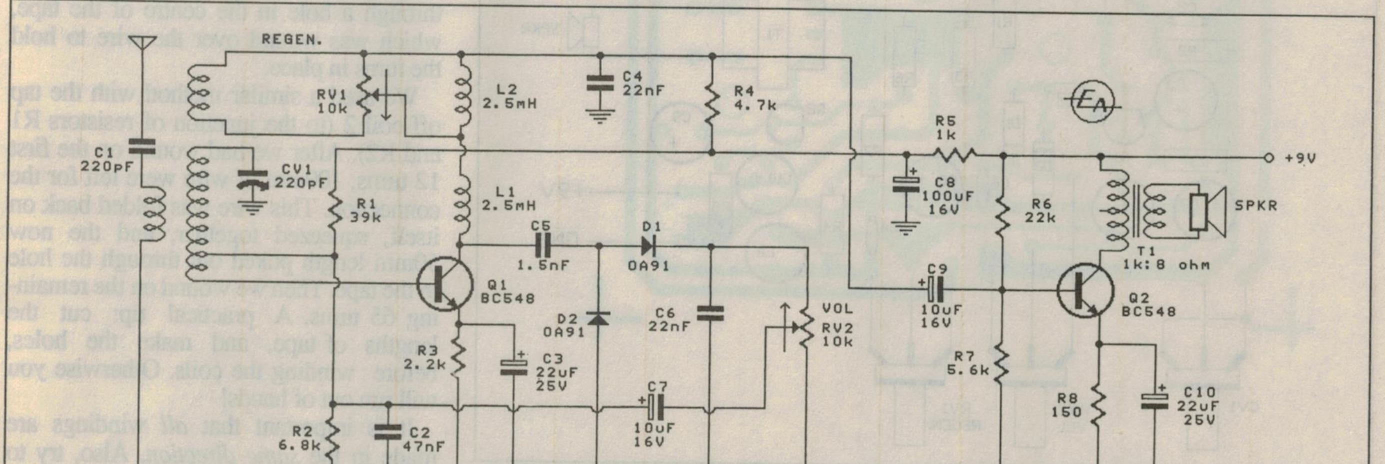



***The radio is housed in a structure built from unused pieces of PCB, which are used as an 'earth plane' to neutralise stray capacitances. Note how the aerial rod is supported by wire loops soldered to the base. Each loop only forms part of a circle, so that it doesn't form a 'shorted turn'.***

Everyone has heard of the simplest radio design — the crystal radio. The radio signal is fed from the antenna to a tuned circuit, detected by the 'cat's whisker' (essentially, a diode), then listened to in a set of headphones.

These sets are not very *sensitive* (able to receive weak signals), nor *selective* (able to pick up one signal and tune out nearby ones).

Improved designs overcame the sensitivity problem by adding amplification, both of the radio frequency (RF) signal and of the detected audio signal. To increase selectivity, the quality factor (Q) of the tuned circuit was also improved by various techniques. One of these — which we have used in this month's design — is called 'regeneration'. Regeneration works by amplifying the RF signal, then feeding back some of the output into the tuned circuit. It is another example of positive feedback. The overall effect is to make the signal we are tuned to stronger than all




***The schematic shows transistor Q1 acting as both an RF and audio amplifier stage (reflex circuit). The positive feedback of the regeneration coil enhances the input signal strength, making the tuner more sensitive and selective.***

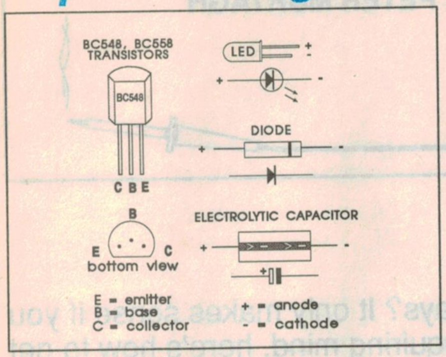



***Fig.2:* The component leads identification diagram for the polarised components used in the circuit.**

other surrounding ones, making it easier for us to tune in to one signal only. The tuner is more selective.

Of course, if there is too much positive feedback, then the amplifier will oscillate, and you hear a very unpleasant howling. The secret is to get the maximum feedback without oscillation occurring.

Another neat technique — which also dates back to the early days of radio design — is called 'reflexing'. It was developed to minimise the number of components needed in the radio. After the audio signal is extracted from its RF carrier, it is 'bent back' (reflexed) to the RF amplifier, so that it is further amplified. As used in our design, transistor Q1 acts first as an RF amplifier, then as stage 1 of an audio amplifier. The two different signals are separated out by using suitable values of capacitors and coils, which offer low and high impedance pathways to the RF and audio.

We have added a second stage of audio amplification to our design to allow you to listen either via low impedance headphones or a small 8-ohm speaker.

In high signal areas, your radio should work quite well without an aerial wire — in fact an aerial could provide too much signal and cause distortion. But in all conditions the set will work far better with a proper earth connection, e.g. to a metal water pipe, etc. We had hoped to extend the project to also pick up longwave and shortwave broadcasts — but we ran into too many problems involving spurious oscillations and instability.

## Construction

Start by winding the three coils. We have specified a rather thick wire — 25 SWG wire (B&S 24), with a 0.5mm diameter — because thinner wires offer a far higher impedance to the RF signals. The more signal present at input means more better selectivity and less noise at the output. Three lengths are required: 40cm (8 turns) for coil 1, the aerial; 300cm for coil 2, which includes the input winding for the transistor (12 turns) plus the main winding for the tuned circuit (65 turns); and 84cm (20 turns) for regeneration, coil 3.

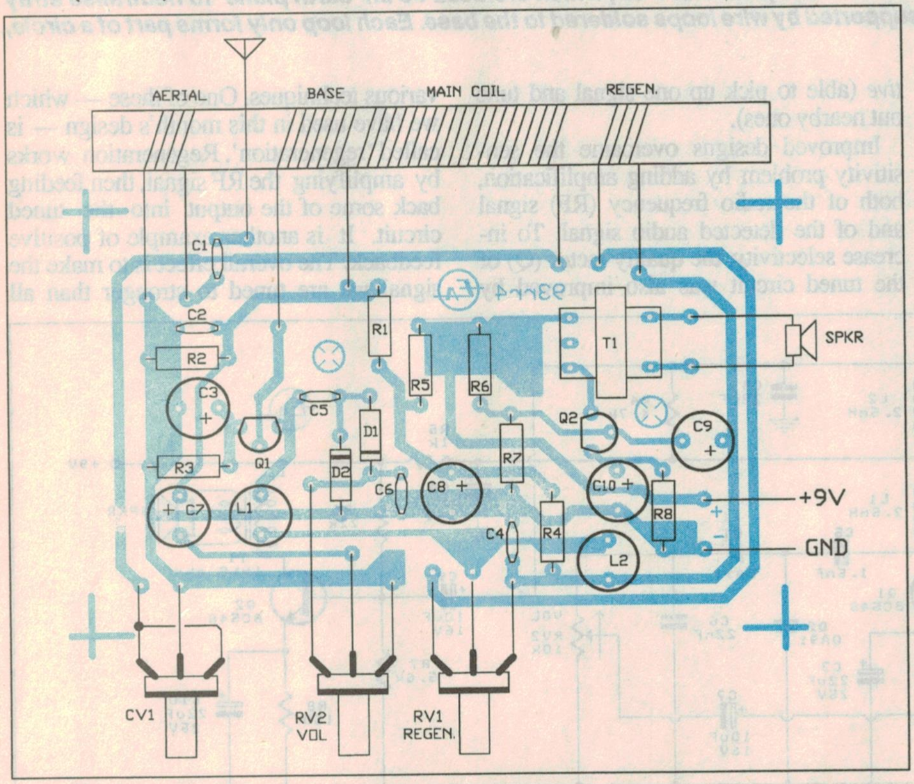



***Fig.1:* The component layout for the PCB. The variable capacitor (CV1) and resistors (RV1, RV2) are shown with their spindles horizontal and their tags pointing upwards. Two mounting holes are also shown for insulated pillars to fasten the PCB to the ground plane.**

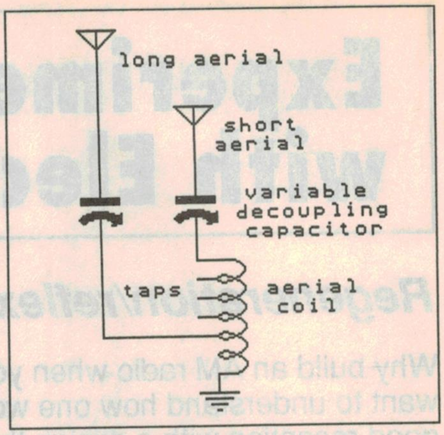



***Fig.3:* When using a long aerial, you can decrease its loading down the tuning circuit by using a variable aerial coupling capacitor, and by winding the aerial coil with several taps to vary the point of connection.**

All coils are wound in the same direction onto a 120mm length of 9mm diameter ferrite aerial rod. (See Fig.1 for their arrangement and connections.)

Because the rod we bought was 194mm in length, we had to cut it to length. A ferrite rod can be snapped quite easily: cut a groove in the rod with a small metal file to cause a weakness, hold the rod firmly on a table or block of wood with the groove directly above the supporting edge; grasp the section jutting out over the edge, and snap down. The rod will break off cleanly at the weakened grooved section.

We used small lengths (about 3cm) of insulation tape to fasten the ends of each coil. The end of the wire was poked out through a hole in the centre of the tape, which was wound over the wire to hold the turns in place.

We used a similar method with the tap off coil 2 (to the junction of resistors R1 and R2). After we had wound on the first 12 turns, 100mm of wire were left for the connection. This wire was folded back on itself, squeezed together, and the now 50mm length poked out through the hole in the tape. Then we wound on the remaining 65 turns. A practical tip: cut the lengths of tape, and make the holes, before winding the coils. Otherwise you will run out of hands!

It is important that *all* windings are made in the *same direction*. Also, try to wind all the turns as tightly as possible, without overlapping any previous loops.

The photo shows how we fastened the rod to the PCB, with two homemade

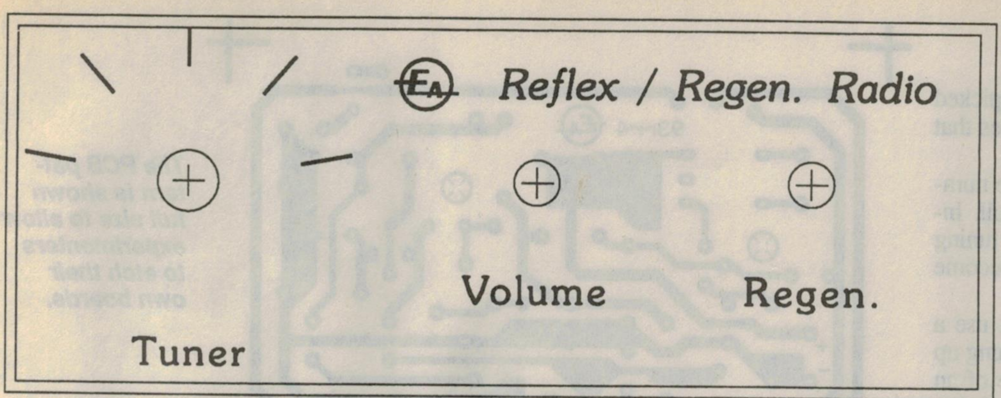



***Fig.4: Here is a full size copy of the artwork for the front panel of our radio.***

wire half-loops. (You must not use a *complete* loop as this would form a 'shorted turn' and interfere with the operation of the coils.)

We soldered the two short lengths of thick copper wire to the base plate, and bent the top sections into semicircles — like a large question-mark! Then we slid 16mm rubber grommets onto the rod to protect it, and squeezed the wire supports to fit into the grooves.

Because this radio circuit has high gain, it reacts to stray capacitance (like us when we touch it!), so we decided to mount all controls on a 'ground plane'.

The front and bottom panels are just two small pieces of unused PCB material, which we soldered together and connected to earth. The negative rail of the circuit is also connected to this ground plane. (If you prefer, a bent piece of aluminium could be used instead.)

Of course, drill the mounting holes for the three front panel controls, and the two holes for the pillars to hold the PCB to the base plate, before soldering the two sections together. In the photo you will notice that we also soldered a side panel — to support the 8-ohm speaker. (Fig.4 gives our design for the front panel, which is also useful as a drilling template.)

Now solder all the components to the PCB, taking the usual care and checking for the correct polarity for electrolytic capacitors, diodes and transistors. (If uncertain, see Fig.2.) Next connect the wires to the tuning capacitor and two potentiometers, as shown in Fig.1.

Finally, connect the leads from the coils wound on the rod. You will need to scrape off the enamel from the ends of the copper wires before they can be soldered to the PCB.

The tuning capacitor we used is a low-cost ($1.95) dual-gang model (nominally 60/160pF). By connecting the two gangs in parallel (see Fig.1 for connection details), this should give about 220pF. When wired up, our capacitor varied from 15 - 215pF.

Because of problems with oscillations with the high gain amplifier, caused by layout feedback, we have not given our usual alternative constructions for stripboard and breadboard. The PCB layout is far more stable for this type of circuit.

## Tuning

To tune in a station, turn both the volume and regeneration to full. Then rotate the variable capacitor. As you approach a strong station, your set will oscillate. Turn down the regeneration (and sometimes the volume as well), until it stops. Tune a little closer, repeating the pattern. The aim is to get the strongest signal without the set 'taking off'. Edge both the volume and regeneration knobs up and down until this is achieved.

The set does not work very well without an earth, but whether you need an aerial depends on the signal strength. Try it with and without an aerial. The price you pay for having an aerial is that the set becomes less selective, as the aerial loads down the tuner.

## Changes

The main change that you can make with this circuit is to extend its tuning frequency above or below its current range. Do this by using less turns than the 65 specified for the main tuner coil (for higher frequencies), or by adding more turns (for lower ones).

As mentioned before, we ran into problems when we added or subtracted too many turns. But it was interesting

### PARTS LIST

***Miscellaneous***

PCB 88 x 55mm, coded 93rr4
9V battery
60/160pF variable gang capacitor CV1
8-ohm speaker or headphones
12cm 9mm-diameter ferrite aerial rod
4.4m of SWG 25 enamelled copper wire
2 10mm insulated pillars
'ground plane' material (see text)
hookup wire, solder, etc.

***Resistors***

All 1/4W, 5%

| | | | |
|---|---|---|---|
| 1 | 39k | R1 | orange-white-orange |
| 1 | 6.8k | R2 | blue-grey-red |
| 1 | 2.2k | R3 | red-red-red |
| 1 | 4.7k | R4 | yellow-purple-red |
| 1 | 1k | R5 | brown-black-red |
| 1 | 22k | R6 | red-red-orange |
| 1 | 5.6k | R7 | green-blue-red |
| 1 | 150 | R8 | brown-green-brown |
| 2 | 10k lin. rotary pots | RV1,RV2 | |

***Capacitors ceramic***

1 220pF C1

***Capacitors polyester (greencap)***

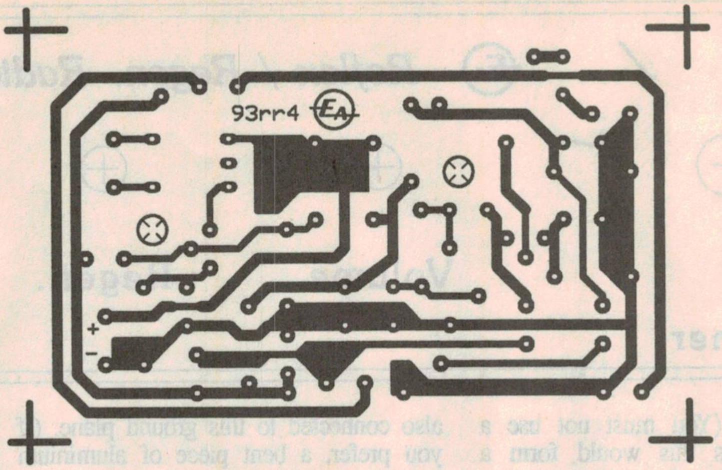
1 47nF C2
2 22nF C4,C6
1 1.5nF C5

***Capacitors PC-mount electrolytics***

2 22uF,25V C3,C10
2 10uF,16V C7,C9
1 100uF,16V C8

***Semiconductors***

2 BC548 NPN transistors Q1,Q2
2 OA91 signal diodes D1, D2




***The PCB pattern is shown full size to allow experimenters to etch their own boards.***

none-the-less. Various signals were picked up, but not always at the frequencies that we expected.

You can also experiment with the number of turns on the regeneration coil. Increasing it will increase the tuning sensitivity, but the circuit will also become more prone to oscillate.

If you do need to add an aerial, use a length of wire about 6 - 7m, and strung up as high as possible. The advantage of an aerial is that the signal level increases, but the aerial loads down the tuning circuit and makes it less selective.

You can further improve your reception with long aerials by replacing the aerial decoupling capacitor C1 with a second variable capacitor, and re-winding the aerial coil so that contact can be made at various 'taps' along it (see Fig.3).

## How it works

The signals absorbed by the antenna flow to ground via a winding on the ferrite rod. This induces a signal in the main coil winding (which forms the tuned circuit with variable capacitor CV1) and also in the small tap winding connected to the base of transistor Q1 (labelled 'base' in Fig.1). The signals in these two sections are out-of-phase, because their common point is effectively grounded for RF — capacitor C1 has little impedance to radio frequencies which are around 1MHz for the medium wave band.

Transistor Q1 acts as an RF amplifier. Resistors R1 and R2 provide the DC bias for the input, while the emitter resistor R3 provides DC negative feedback to stabilise the circuit. The RF signal is amplified by Q1, with various capacitors offering a low impedance pathway for both input and output currents (e.g., C2, C3 and C4). The two inductors L1 and L2 offer high impedance to RF, so they load the transistor output.

Variable resistor RV1 controls the amount of positive feedback for regeneration. It has its minimum value with the pot fully anticlockwise when it shorts out coil L2. As it is turned clockwise, more signal is fed into the regeneration winding. We have already noted that there is a phase reversal between the main coil winding and the tap winding; as the signal is amplified by Q1 there is a further 180° phase change, so this means that the regeneration signal is now back in phase with the tuned circuit winding — giving positive feedback.

The RF signal is rectified by diodes D1 and D2, and develops across capacitor C6 and resistor RV2 a steady voltage, proportional to the average RF carrier level, which has the audio voltage superimposed upon it.

Usually only one diode is used to extract the audio 'envelope' from the carrier, but we have used two diodes to get a stronger signal. During the negative half-cycles, capacitor C5 becomes charged — as diode D2 conducts — until the peak signal voltage is reached.

Then, during the positive cycles, the voltage on C5 will add to the signal voltage and charge up capacitor C6, via diode D1. C6 will tend to develop a voltage roughly equal to twice the peak value of the input signal. Hence, this arrangement is called a 'voltage-doubling' detector.

Variable resistor RV2 determines how much of the audio signal is 'reflexed' — that is, sent back via capacitor C6 to transistor Q1 for further amplification. Resistor R4 then provides the transistor's load for the audio frequencies, since the coils L1 and L2 provide them with a low impedance pathway (unlike the high impedance of the coils to the RF carrier frequencies). Conversely, capacitor C4 has a low impedance for RF, but not for audio.

Resistor R4 could be replaced by high impedance headphones; but since they are not so easy to find these days, we have added a second stage for audio amplification for an 8-ohm load. The output of transistor Q2 will drive, via the 1k:8-ohm audio transformer T1, either a set of low impedance 'phones or a small speaker.

This section is a typical Class A amplifier, with resistors R6 and R7 providing DC bias, R8 stability, capacitor C8 isolation, and C9 an AC bypass. This reasonably simple 2-transistor circuit provides quite reasonable selection and amplification. Hopefully, building it will increase your understanding of how radio works.

## Some radio theory

The purpose of the tuned circuit is to select one only of the various RF signals picked up by the antenna. To do this, we combine a coil and a variable inductor.

Both these components impede AC signals, but very differently. With an inductor the impedance *increases* with increasing frequency, whereas with a capacitor it *decreases*. This means that for each radio signal there is a combination of inductor and capacitor values which gives a *resonant* frequency, which occurs when the inductor current equals the capacitor current.

The energy stored in the circuit is alter-

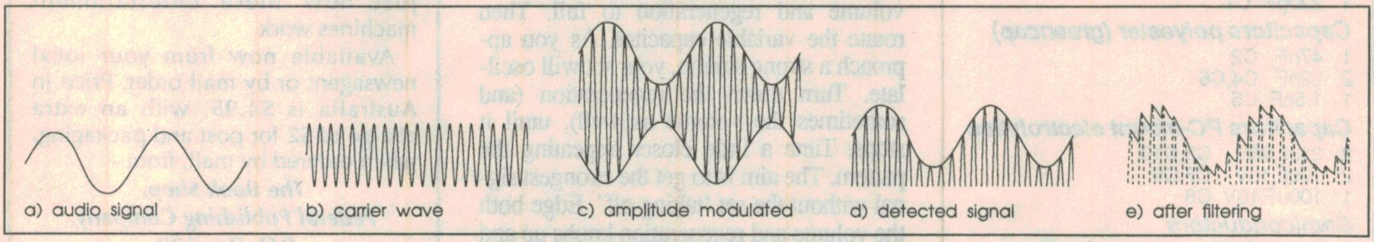



***Fig.5: Here are the various waveforms involved in an AM radio. The first two signals are used to make up the transmitted AM wave, and the receiver extracts the original audio from the detected (rectified) signal.***

natively transferred between the two components — back and forth. In an ideal circuit, without resistance, this oscillation would continue forever.

This parallel combination of inductor and capacitor is also called a 'tank circuit' because it offers maximum impedance to the resonant frequency, and so the incoming energy at that frequency tends to be stored in it. There are losses, of course, due to the circuit resistance plus the current which flows off into transistor Q1, but these are replaced by the regeneration signal which provides positive feedback.

In practice, the tuned circuit allows us to select one RF frequency which will be at a higher level to all others — this signal is then amplified and detected.

Refer to Fig.5 to see the various aspects of the amplitude modulated (AM) wave, which is the type of wave that our radio set is picking up. A relatively low frequency audio wave (Fig.5a) is used to vary the strength of a much higher frequency carrier wave (Fig.5b). By itself, the carrier has a constant amplitude. However, when it becomes amplitude modulated, its amplitude is altered by the audio wave (Fig.5c). The audio signal is like an envelope which determines the height of the carrier wave.

The process of detection (via the rectifying action of a diode) recovers the audio from the AM wave. After passing through the diode, half the wave is removed, so now all the oscillations occur with the same polarity (in our set, all positive, Fig.5d). This signal is then used to charge up a capacitor (C6 on the schematic). Notice the distortion on the audio waveform caused by this method of detection (Fig.5e). It is more pronounced on the rising voltage, since the capacitor starts to discharge between each increasing peak. The value of C6 is chosen to filter out the remaining RF.

Finally, the audio signal passes across a larger value coupling capacitor (C7) to remove its DC offset, to be further amplified and fed to headphones or a speaker.

## Transparencies

As usual, a high contrast, actual size transparency (negative) for the PCB used in this circuit is available for only $2. This will allow you to etch your own printed circuit board. This special price applies for transparencies for all projects in this series only. Write to *EA*'s reader services division.

Happy experimenting — and please send us your comments on the circuits we have published, as well as ideas for future projects. ❖

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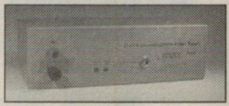

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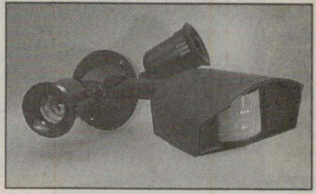

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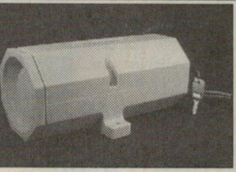

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C 9070 Standard Model **$189.00**

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Includes quality velcro strap and simple push-button operation.

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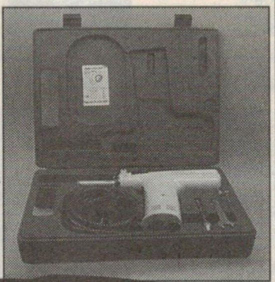

**Exclusive to Altronics in Australia.** This stand alone, fully self-contained desoldering tool makes it a breeze to remove components from any PCB. Even double sided, through hole plated boards. All it needs is a squeeze or two on the trigger and the component virtually falls out. **Features:** • Totally self contained • Light and compact • Anti static tip • Easy to use • Simple to clean and maintain • Variable tip temperature. The ***Sure Shot*** generates a high speed vacuum every time the trigger is squeezed. This vacuum causes the molten solder to flow into the collection reservoir contained within the unit. Here the molten solder solidifies into small particles. With its inbuilt variable temperature control the ***Sure Shot*** is ideal for single sided, double sided and through hole plated P.C.B.'s. With just a couple of squeezes of the trigger all holes are left solder-free for easy removal of the component.

*The Micron Sure-Shot Hand Held Desoldering Gun de-solders 30 plus joints a minute and is around half the cost of the competition*

T 1270 **$349.00**

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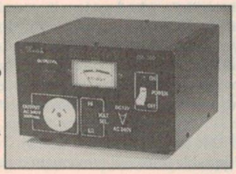

This nifty inverter converts 12 Volts DC to 240 Volts AC. Includes an on/off switch and a light & heavy load switch with metered output. Works well with most electrical equipment.

M 8120 NORMALLY $249.00

This Month Only **$199.00**

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## Micron Soldering Station

**Electronic Temperature Controlled, Temperature Selectable, Soldering Station**

Features variable temperature control, LED bargraph temperature readout, quality silicon lead, light weight handle sponge tray, and super heavy duty iron clad tips etc. Range of tip sizes available.

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*Suits Hobbyists and Professionals Alike!*

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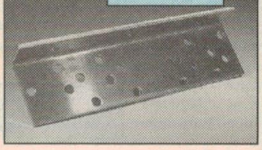
*50% Off!*



We have a limited quantity of these great brackets. Made from heavy duty 3mm aluminium. Pre-drilled for four TO-3 transistors and three mounting bolts. Dimensions 152w x 42d x 23h mm approx. Fantastic for power supplies, amps etc etc. Sorry Not Available from Altronic Re-Sellers

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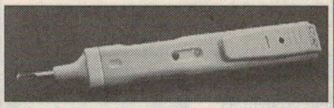


This fantastic gadget will test a myriad of electrical and electronic components. It is simple to operate and is sure to amaze you with it's uses. Best of all, it's priced to make it a must for every technician, electrician and enthusiast. Tests continuity/resistance (100MΩ, 50MΩ and 5MΩ ranges), with buzzer and/or LED indication. Dead easy to use. Will check fuses, light bulbs, wiring, elements, speakers, diodes/LEDS, transistors, transformers and the list is endless.

Q 1250 Amazing Low Price **$17.95**

## Digital Voltmeter


This well designed LCD module will take care of most of your requirements of digital voltmeter displays. Voltage range and decimal place options are easily configured by PCB links. Small, compact, reliable and comes complete with plastic surround to give a professional finish.

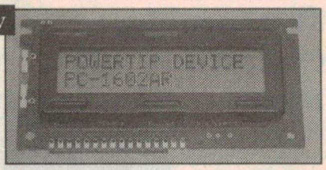
**Specifications:**
**Digits:** ................3.5, 13mm Height
**Ranges:** ....200mV, 2V, 20V, 200V, 1000V DC
**Input Impedance:** ................10MΩ
**Power Supply:** ................9V DC
**Over-range Indicator:** ................'1'
**Decimal Place:** ................Variable
**Accuracy:** ................+/-0.5% (2 digit)

*Ideal for Power Supplies Etc.*

New From ALTRONICS

## Alphanumeric Dot Matrix LCD Module

New



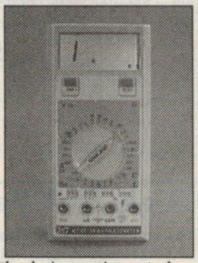

This compact LCD module has 96 inbuilt ASCII characters and 92 special letters which can be displayed on a 16 character by 2 line screen. The module will hold the current input on the display using its own built in memory, thus making it very easy to drive. Some possible applications could be within fax machines, measuring instruments, telephone applications or any other area where machine user feedback is required.

Z 7299 **$35.00**

*This Module can be Programmed for Personalised Messages for Your Car, Alarm System etc. etc.*

## Digital Multimeter & LCR Meter

*Includes Carry Case*



This digital meter tests in addition to standard multimeter ranges, capacitance and inductance, enabling you to test a wide variety of components.

Indispensable for the design engineer, technician and enthusiast alike.

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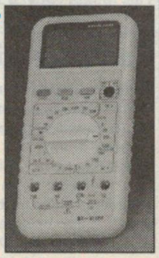
## Universal Multimeter Carry Case Q 1052

**Excellent padded vinyl case with zipper. Suitable for all meters advertised this month.**

**Free With Each Multimeter Ordered this Month**

## 24 Range Digital Multimeter



**Features 1% Accuracy and Massive 20A Current Check.** 3.5 digit. Ranges include AC & DC voltage, AC & DC current, resistance, diode check, transistor check etc. this meter would have to be one of the best value multimeters available today.

New

Q 1030 **$99.00**

**Q 1040 Protective Holster to Suit $15.95**

## 24 Range Digital Multimeter


**With Frequency Measurement and Capacitance Meter.** Includes frequency and capacitance ranges. With the addition of a built in logic probe and screen hold button it would have to one of the most useful DMM's available today.

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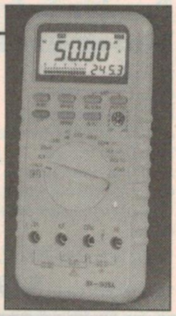
New

## Auto Ranging 3.75 Digit Digital Multimeter




**Triple LCD Display Includes 2 Digital & 1 Bar Graph.**

This incredible multimeter would have to be one of the most comprehensive on the market today. It is capable of doing all the normal voltage, current and resistance readings, as well as capacitance, frequency, minimum and maximum sampling, relating measurements, storing previous readings, limit setting, signal transistor gain checking and is full auto-ranging.

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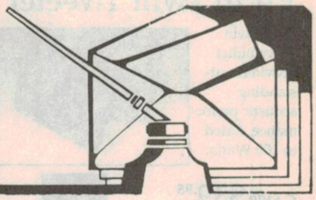


Conducted by Peter Phillips

## Diabolical thyristors and some more answers

**We have quite a bit of discussion this month on phase-controlled transformers, a whinge about component prices and some interesting answers to previous What?? questions. And I'm sure not everyone will agree with my comments about old radios!**

Hands up (metaphorically speaking) those who know all about electronics. It's a silly question of course, as no one would dare claim such omnipotence, regardless of their experiences.

Take me, for example. I've been in the field for over 30 years and have dabbled in pretty well every area electronics has to offer. But despite years of study, practice and complete involvement in the field during this time I could fill many pages on what I *don't* know. And at the top of the list I'd put thyristors!

That's not to say I haven't used them in designs, studied them, and spent hours discussing their characteristics and peculiarities with colleagues. But I've decided after many years that the SCR and the triac are the most diabolical solid state devices known to man. Here's a few reasons...

About 12 years ago I wanted to operate my reproducing piano (a type of player piano) from a computer instead of using the traditional piano roll. Through a series of events I ended up using SCRs as the drivers of the electric solenoid valves required to interface the electrical signal to the vacuum operated system in the piano.

It worked fine. Then I built another one for a friend. No way would it work, until I added a few capacitors here and there to prevent some of the SCRs switching when they shouldn't.

Another unit exhibited different SCR problems, a fourth was different yet again, and so on. Even now I am not sure what the final design should be, despite building over 10 units.

Recently I designed a simple temperature controller using a triac. The load is purely resistive and takes about 200W — well within the specifications of virtually every triac on the market. But it took quite a few dead triacs, opto-isolators and a lot of angst on my behalf before I had a reliable circuit. This is despite following all the rules. But then, what *are* the rules when it comes to thyristor devices?

For this reason, I'm pleased to start this month's offerings with a couple of letters about driving a transformer with a thyristor phase-control circuit.

After all, anything that gives an insight to thyristor operation is welcome as far as I'm concerned. And I suspect there's one or two readers who might agree with me!

### Thyristors & Xformers

You might remember a letter on this topic in February, where the writer (who makes salt chlorinators) stated he had given up the idea of thyristor phase-control as it caused too many transformer failures.

Our first letter disagrees with this, and gives quite a good description of the problem and its solution.

The writer is a design engineer with Fastron, who make a range of products that use phase-controlled transformers. He's therefore in a pretty good position to comment...

*I am writing in reply to the letter from R.S. (Barmera SA) in the February 1993 edition of EA, regarding transformer primary phase control for secondary voltage control.*

*A large part of the business at Fastron is in phase angle controllers. These start at 20A and go to tens of thousands of amps, single and 3-phase. In the large units, which are typically electro-plating rectifiers with six or 12-phase rectifiers on the secondary, control is achieved with phase angle control of the incoming 3-phase to the primary of the transformer. Control is normally in current source mode to compensate for differing resistances when each load to be plated is placed in the tank.*

*More commonly, we supply 6V, 400A AC supplies to Australian Fibre Optic Research for high-speed high-temperature furnaces. These are also of the primary phase control types, operating this time as voltage source with current limit and trip via a secondary current transformer. These furnaces heat to 1500°C in about five seconds.*

*A large number of our units are connected directly to resistive heating loads such as silicon carbide (which changes its resistance by a factor of three over its lifetime) and molybdenum disilicate (which starts off as essentially a short-circuit when cold).*

*This should give you an idea of the type of work in power electronics we do at Fastron. Now to R.S. and his contact called Des...*

*In my experience, the main problems associated with phase angle control of transformers involves saturation of the core. This is true for both single and 3-phase transformers, regardless of the core size involved. If the switching device (triac or SCR pair in inverse parallel) is not triggered at the same phase angle for both positive and negative half cycles of the mains AC, then a DC offset will occur and the core MAY be saturated. The saturated core will draw excess current (up to 10 times or more, depending on the core size) and destroy the switching device on over-current, or burn out a winding due to excessive heat build- up.*

*Another problem is poor triggering to the switching device. Too little triggering power will cause a device not to trigger, with the result being a missed half cycle and DC offset again. A point not commonly known is that the data in most short form sheets quotes trigger current at*

*25°C, and that at 0°C the actual trigger current may be twice this value. Most of the AEG/SIemens SCRs we use (and are agents for) typically have a trigger current of 70mA at 25°C, but this can rise to 400mA at -40°C. Of course, once the device heats up, the trigger current falls (typically 50mA at 125°C), but by then the damage may have occurred.*

*The last way is normally associated with controllers that are not soft start; that is they ramp up from zero. If the last half cycle of conduction was (say) the positive one, then the core will be sitting at the remanent flux level on the positive side. If the next cycle triggered is the positive one, then the flux associated with the applied voltage will add to the remanent flux, possibly resulting in saturation and its problems.*

*If the applied voltage at each start-up is small, then the added flux lies within the non-saturation range of the BH curve for the core and saturation is avoided. The voltage can then be ramped up slowly (soft start). If however the applied voltage is (say) full volts, then the flux from this can add to the remanent level and push the core into saturation until stabilisation occurs.*

*This is in fact a normal occurrence every time a transformer is turned on, and relies on the exact part of the cycle of the AC supply that the transformer was switched off and at what part of the cycle it was switched on. The effect can be more or less pronounced depending on the randomness of these two events. (It's impossible to accurately turn off a switch at the zero crossing on the AC supply).*

*Because a triac is much less tolerant of surge current than an SCR, they are more prone to failure on transformer in-rush or saturation faults if not sized correctly. Mr R.S. did not say how big the light dimmer was, but most of them are 500W or so, and incorporate a very small triac normally only rated at 600V PIV, not the 800V type that should be used for phase angle control. The triggering control in these units is fairly rudimentary and is normally only a pulse type, not a DC trigger as I would recommend. The balance between positive and negative half cycles can sometimes be very poor.*

*At Fastron, we have supplied many units for primary control of the approximate size that I guess the chlorinators made by R.S. are. These vary from welders to regulated phase-angle controlled power supplies, and we have had no problems. This is not a run of good luck, but a knowledge of the proper design practices for transformer primary control by phase angle.*

*By the way, all our transformers are made by Altro Transformers in Cambellfield in Melbourne. I hope I have shed some light on this matter.* (A.M., Dandenong Vic).

As I understand your letter A.M., the answer lies in the trigger circuit. Most simple phase control circuits use a resistor in series with a capacitor, with a diac connecting the capacitor to the gate of the thyristor. When the capacitor voltage reaches the firing voltage of the diac, a pulse of discharge current flows in the gate circuit, firing the thyristor device. But presumably this is not good enough in an inductive circuit.

The next letter is from a regular contributor to this column, and as you'll see, he agrees with A.M. He also makes a couple more points about light dimmers.

*The 'chap called Des' was heading in the right direction when he implicated the transformer's 'magnetising' curve as partly responsible for the problem, but let's have a closer look at how it is involved...*

*First the light dimmer, of which there are many and varied circuits. The great majority take no care to equalise the average value of current drawn by the load during odd and even half-cycles, while energising the controlled device for variable short parts of each supply voltage half-cycle.*

*In fact some dimmers practically guarantee that there will be a substantial difference by using an asymmetric diac as a voltage reference in an otherwise symmetrical circuit. There are others which claim to achieve 'economy' by fully energising the load (via a diode) for odd half-cycles, with a controlled thyristor mediating the evens. Even apparently symmetric triac circuits can have asymmetric output (particularly in the short term), due to component inequalities and memory effects.*

*Not that this matters for an incandescent lamp or any other non-inductive load, other than the fact that it can make local supply authorities rather cross. Inductive devices, including transformers are another story:*

*When the asymmetry persists over an appreciable period, it becomes evident as a DC component. Now consider the effect on the magnetisation curve. Enough DC and the part of the BH curve being used is the level non-linear extremity instead of the steep linear centre. Since the incremental permeability of the core is proportional to the steepness of the part of the BH curve we use, out there the core becomes largely non-magnetic. Result: the primary inductance largely disappears and the transformer primary in effect turns into a low resistance. A very large primary current can be drawn, shortening its life by overheating.*

*The short-term version of the effect can be more insidious. While a steady DC component can be readily checked for by using a DC ammeter (preferably a moving coil type for a steady reading), asymmetry over short periods (say 6-20 cycles) may be difficult to detect. In particular, it may not be unidirectional but swing from one extreme of the BH curve to the other. There will be the same sort of overheating, on a reduced scale but still capable of destruction. Such asymmetry can be thought of as causing the load current to have substantial components at sub-harmonic frequencies like 25Hz, 16.7Hz, 12.5Hz and so on, which are not handled properly in a transformer designed for 50Hz.*

*Yes, Peter — a larger transformer will reduce the risk, but NO, it would not be sound practice because it is not a designable situation.*

*It would be far better to spend the extra money by redesigning the controller for symmetrical output. For instance, a principle which I have used in other applications is to turn the controller ON only at a zero-crossing and to leave it ON for one whole cycle then turn OFF at zero-crossing (which a triac does naturally). The delay until next ON is determined by the dimmer setting, being zero for full power. This not only avoids asymmetry, but also the RF interference which can be a nuisance with other designs.* (G.W., Florey ACT)

Thanks G.W., you've answered a question I've pondered on since I designed the fan speed controller described in July 1991. In the article describing this project, I mentioned that a commercial light dimmer soon burnt out when connected to a small exhaust fan. My design is rather similar to a light dimmer, and yet the prototype is still happily controlling this very fan. Why?

The reason is my circuit uses a symmetrical diac as the trigger device, while the light dimmer used an asymmetrical device. Therefore, unlike the light dimmer, my circuit doesn't introduce a DC component in the stator of the fan motor, causing saturation of the stator, an increased load current and the demise of the triac.

The temperature controller I mentioned in my opening remarks uses the ON-OFF control referred to in G.W's letter. This sort of control is ideal with a heating element, due to its thermal inertia. However, I found during the development of this circuit, that unless the triac is triggered properly, this type of control can quickly become half-wave.

## INFORMATION CENTRE

This supports A.M's comments about DC triggering, which was the solution to my design problems. Here the gate is turned on, and held on for the duration of the cycle, instead of receiving a short, sharp pulse at the start of the cycle.

So there it is, you *can* operate a transformer with phase controlled thyristors, providing the circuit is properly designed. Use zero-crossing switching if possible and don't use an asymmetrical diac.

### Better answers

The answers I give to the What?? questions are not guaranteed as either the only one or even the best one. While I can't make it a practice to include every answer I receive to a particular problem, I'm presenting the following as they are both interesting and clever. The first deals with the February 1993 What?? question, which dealt with a precision rectifier:

*The precision rectifier problem of February '93 seems too simple as there are several circuits that do this. I have used the circuit shown in Fig.1(a) in an audio level meter. The circuit comes from the magazine Electronic Design, July 1984, page 255. It relies on op-amps that have inputs which can be connected to a supply rail, such as the CA3130, LM324 and so on.*

*As you can see, it uses only one op-amp and NO diodes! For the negative half cycle, the gain is -R2/R1. For the positive half cycle the gain is R3/(R1 + R2 + R3). For symmetry both gains should be equal. Suggested values are R1 = 22, R2 = 18, R3 = 180 giving a gain for both half cycles of 0.81.*

*Another solution which avoids the input to the supply rail constraint is shown in Fig.1(b). This circuit uses a diode, but the same equations apply.* (Glenn Baddeley, Burwood Vic).

Thanks for these circuits Glenn. Other readers have sent similar solutions to the problem, so perhaps the question was too easy. Hmmm!

A question that seems to attract increasingly better answers is the 'pi' ohms network made from 1 ohm resistors. A solution involving 15 resistors was published in February, and this month we're down to 13. The circuit is shown in Fig.2 and comes from Jeffrey Harrison, Mt Waverley Vic. Congratulations Jeff, this is the best so far!

### Component prices

The topic of component prices has not been raised before, which, judging from the next letter, seems rather strange.

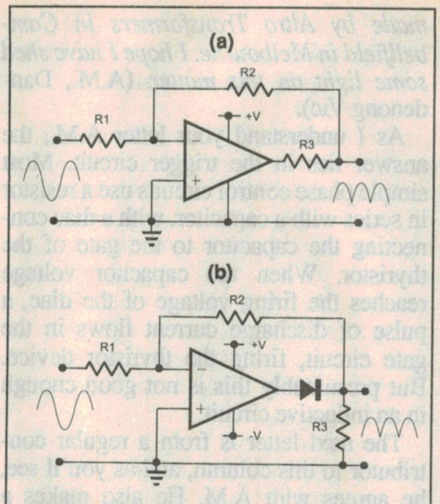



Fig.1

*I'm a kid of 13 and very keen on electronics. But being short of financial resources I have to shop around very carefully.*

*I have a number of current catalogs, and I find the prices of components vary considerably — not by a few cents, but often by large amounts. Prices vary not only between companies, but between stores owned by the same company. For instance, the TL074 IC costs $5.50 from Jaycar, $3.95 from Dick Smith Electronics and $1.60 from the electronics shop called TECs.*

*A piece of double-sided blank printed circuit board measuring 300 x 300mm costs $24.95 from Dick Smith and the TECs price is $14.95. In the Dick Smith catalog, a DPDT sub-miniature slide switch is 75c, but when I went to the Dick Smith Electronics store in Colac, the same switch was $2.95.* (D.R., Stoney Ford, Vic).

There's an old saying in business: charge what the customer will pay, not what the thing really costs. Markups are often very high on components, as they are on car parts and similar items.

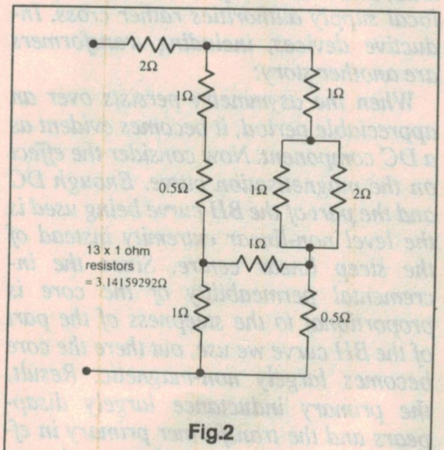



Fig.2

So, what's the answer? If you believe in the 'free market' philosophy, prices will be kept down by healthy competition. It seems you already have this in TECs, so obviously you would patronise this store where possible. If everyone in the district does this, the 'big boys' will soon lower their prices.

But other than 'buyer resistance', the only other answer is to shop around. There are quite a lot of electronic component outlets, although many are only accessible by mail order. And from your letter D.R., you've already learnt the value of checking prices.

### HP 2645A terminal

I'm presenting the next letter in case someone can help:

*I have a Hewlett-Packard 2645A Terminal. Would you be able to advise me as to where I could get more information on it. Would I be able to use it for any other purpose than just a terminal?*

*Maybe a reader might be able to help me.* (M. Preston, 7 Morrison Avenue, Mt Martha 3934 Vic.)

I suppose you've already tried the obvious by contacting Hewlett-Packard, whose Head Office address is 31-41 Joseph Street, Blackburn, Victoria 3130. We are not familiar with this unit and can only speculate on its potential use. Perhaps someone can assist?

While I don't want to advertise the fact too much, it seems reader enquiries such as Mr Preston's get answered. In February, a reader asked about LCD glass, and I've since received a copy of a letter sent to the reader by a company who might be able to help.

The interesting point raised in this letter is that LCD glass is not made in Australia. While Japan is still considered a leader in the technology, LCD glass is made in Hong Kong, Singapore and Taiwan.

### Old radio

Here's a letter I'm sure will strike a chord with many readers. But I wonder how many readers will disagree with my reply!

*I was recently given an old valve radio. It has had continual use over the years and still works. The radio is an Airzone, in a cream coloured case and I think it was made in the 1940's. It still has all the original components and I was wondering whether I need to replace all the capacitors (etc) if I want to keep using it.* (T.S., Carlingford NSW).

There are various schools of thought when it comes to old radios. One view is to preserve its originality at all costs. Another more pragmatic view is to make the necessary repairs inside, while main-

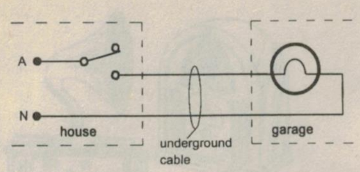



Fig.3

taining the appearance of the outside. Sometimes, owners of old radios restore them to something beyond their original state; something the purists frown on.

However, there is a safety aspect that can't be ignored, regardless of your point of view. A few years ago, a friend of mine lost virtually everything in a fire caused by an old radio. It seems he turned the radio off at its on-off switch on the volume control (or thought he had, except the switch was faulty) and went out to lunch.

The mains transformer picked this time to develop a fault and before long his shop-residence was in flames. Because he wasn't insured, he lost a life-time's work.

Therefore, I believe if you intend using the radio, make it safe. That is, replace the mains lead (you can get look-alike mains cord), place a fuse somewhere in the circuit (which can be external to the radio) and, yes! replace the capacitors.

There is little doubt the capacitors will be leaky, and certainly in need of replacement. The old style electrolytic capacitors can be left in place (but disconnected) and new ones fitted discretely somewhere under the chassis.

The coupling and bypass capacitors (mostly paper types) can be replaced with polyester types.

By doing this, you eliminate the vexing problems of intermittent operation, hum, distortion and other nasties caused by leaky capacitors. Just remember to use suitably rated capacitors, usually 400VW at least.

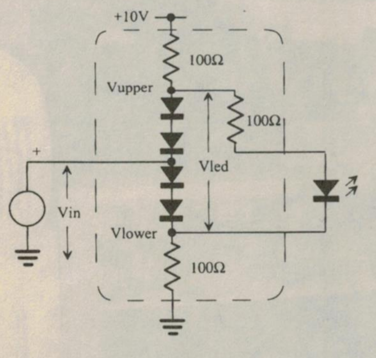



Fig.4

## What??

As far as I can remember, this month's question is only the second of its type I've presented. Like the previous question, this one is about switching lights in an improbable way. It comes from Ian Du Rieu, who had to solve the problem in real life. Ian writes...

*I have a garage with a single 100W light, wired by a two-conductor underground run to a switch in the house as shown in Fig.3. I want to add a second 100W light on the outside of the garage to light up a pathway.*

*This light is to have 2-way switching, where one switch is in the garage and the other in the house. The original garage light will now be operated by its own switch in the garage.*

*Without running any extra cables to the garage (as it's not possible), and without spending more than $40, how do you do it?*

(By the way, a bit of lateral thinking is needed here — P.P.)

## Answer to April's What??

A possible circuit is shown in Fig.4. When Vin is at half the supply voltage, Vupper will be two diode voltage drops above Vin while Vlower will be two voltage drops below Vin. The voltage Vled is equal to the difference between Vupper and Vlower, that is four diode voltage drops. This is enough voltage to cause the LED to light.

If Vin increases, Vupper and Vlower will initially track the change. However, Vupper cannot exceed the positive supply rail, while Vlower has no such restraint. When Vin is two diode voltage drops below the positive rail, Vupper is equal to +10V (ignoring the current drawn by the LED).

Now as Vupper is limited to this value, if Vin and hence Vlower increase further, then Vled will decrease. Vled will fall to zero when Vin exceeds the supply rail by two diode voltage drops.

A similar description applies as Vin approaches the zero volt rail, except now it is Vlower that is constrained.

This explanation doesn't take into account the finite voltage drop across the LED, nor the voltage drop across the upper and lower resistors due to the current drawn by the LED.

When the circuit was constructed it was found that the current through the LED decreased to 50% when the input voltage was within 1.3V of the supply rails (i.e. at +1.3V and +8.7V) and fell to zero when Vin was 0.4V outside the supply rails (at -0.4V and +10.4V). Try it! ❖

## NOTES & ERRATA

**DSO ADAPTOR** (February 1993): There is an error on the PC board. Pin 16 of IC4 (74HC157) is currently floating, whereas it should of course be connected to the adjacent +5V supply rail. The IC pin can usually be bent over to reach this supply track, and soldered to it.

The reproduction of the PCB pattern on page 83 of the February issue also shows the pad for pin 1 of IC2 (74HC393) shorted to the adjacent track. This is a printing error; the two are not connected. The board pattern negatives supplied to the PCB manufacturers are correct, as are those available via the Reader Information Service.

**MORSE CODE INTERCOM** (February 1993): The Morse code table incorrectly shows 'di-dah-dit' as the code for the letter 'S' (and 'R' does not appear). The code list should have shown 'di-dah-dit' for 'R' and 'di-di-dit' for 'S'. ❖

## NEW KITS FOR EA PROJECTS

Jaycar Electronics has advised us of its release of the following new kit for a recently published *EA* project:

**LOW COST 1GHZ COUNTER** (April 1993): Jaycar's kit is complete with punched and screen-printed front and rear panels, and includes all specified components. Resistors are 1% tolerance, and where appropriate capacitors are of the MKT poly type. The kit has the catalog number KA1750, and is priced at $149.50.

Dick Smith Electronics has advised us of its release of the following new kits, for two recently published *EA* projects:

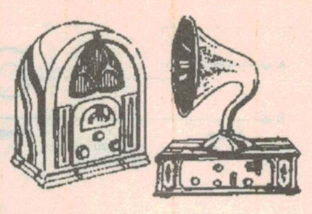
**PROGRAMMABLE DOORBELL** (April 1993): DSE's kit is complete, with all components as specified including PCB, DSE's deluxe moulded doorbell case as mentioned in the article, hardware (including battery holder) and one pushbutton switch. The kit has the catalog number K-3802 and is priced at $39.95. Additional pushbutton switches and cable are available as normal stock lines.

**LOW COST 1GHZ COUNTER** (April 1993): DSE's kit is complete with all specified components and includes a pre-punched rear panel, plus a pre-punched and silk-screened red perspex front panel. The kit has the catalog number K-7604 and is priced at $159.

*NOTE: This information is published in good faith, from information supplied by the firm or firms concerned and as a service to readers. Electronics Australia cannot accept responsibility for errors or omissions.*

# Vintage Radio

by PETER LANKSHEAR



## Vintage radio in London

**One of the major attractions of overseas holidays is seeing how the 'other half' lives and of course for many of us, this extends to hobby interests. British and European vintage radio is significantly different from ours, and *EA* readers visiting London would be well rewarded, if they take time off to visit two splendid and internationally recognised — but very different — displays of historically important electronic equipment.**

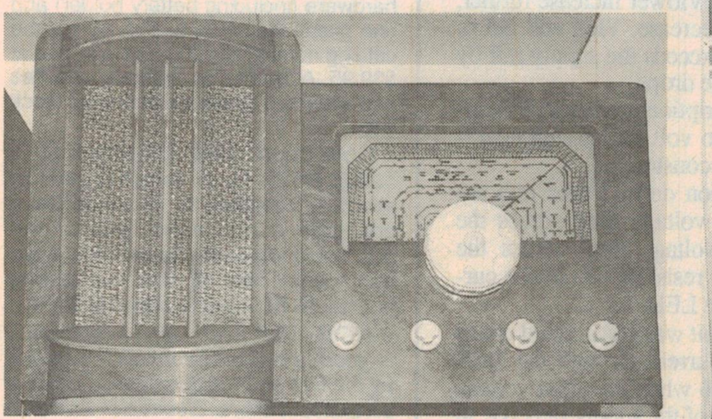
Much of the early work in radio was carried out in England, by famous researchers. Names such as Lodge, Marconi and Fleming are examples, and it is fitting that the British National Museum of Science & Industry in Kensington, one of the world's leading institutions of its type, should feature their work and that of other pioneers. Housed in a magnificent building, the Museum has several fascinating displays of early electrical and electronic equipment, justifiably treated as milestone developments. Although individual exhibits are subject to change and at any one time represent but a small part of an enormous amount of equipment owned by the Museum, there is always plenty to see. Documentation of displays is, as to be expected, of the highest order.

Recently I was fortunate in being able to spend a day there and naturally, I found the early radio displays to be most absorbing, from Marconi coherers through Fleming's diodes to a complete 1910 Marconi ship's radio cabin and even Alexanderson RF alternators. More modern and domestic equipment can be seen too, and there is a working amateur station GB25M in frequent operation.

Be warned, though. There is such an enormous range of important and unique equipment on view that at least one whole day should be set aside for a visit. Furthermore it is easy to get sidetracked to other subjects. For example, I spent more time than I could really spare in the railway locomotive section, which includes none other than Stevenson's original 'Rocket'.

Computer enthusiasts too will find much of interest, with historic models such as Alan Turing's 1946 'Pilot Ace' on display. But the most exciting must be the recently completed three-tonne working construction of the mechanical


***Right: Gerald Wells' recreation of a McMichael dealer's shop, typical of the valve radio era. An essential item of equipment was the valve tester, often located on the counter so the customer could be shown the condition of their valves.***



***Visitors to the Wells museum find many of the cabinets interesting. This Radio Acoustic Products model of 1946 is very different from its Australasian contemporaries.***

Babbage Difference Engine Number 2, designed in 1847-49 and intended to tabulate the value of 7th-order polynomials to 30 decimal places. The first automatic calculator to be designed, it remained a set of 20 drawings until 1991, when it was built to commemorate the 200th anniversary of Babbage's birth and to confirm the soundness of his ideas.

## Monster spark coil

There is a wide range of early electrical equipment, from a vast collection of lamps, to the biggest induction coil ever made: the Spottiswood, containing 450km of wire in 340,000 turns, and capable of producing a spark over one metre long! Here too are the examples of the classic frictional electric machines, including Wimshurst and Van de Graaf generators.

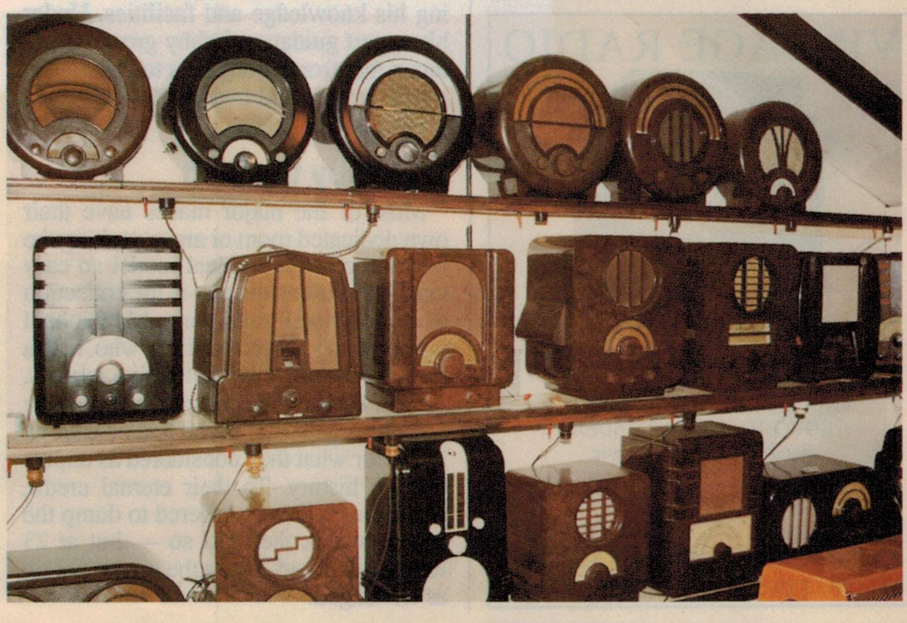
In the Time Measuring section is a surprise exhibit, a comprehensive display of crystal oscillators. Telecommunications, the parent of radio, is well represented, from a 1837 Wheatstone needle telegraph to equipment of the 1980's.

## Private museum

Sharp eyed viewers of British TV productions will have noticed that radio receivers used as 'props' are invariably of the correct period. This is no coincidence, as it is likely that they will have been on loan from Europe's major vintage radio collection — that of Gerald Wells, of 23 Rosendale Road, West Dulwich, a suburb of South London.

Gerald has been an active worker with radios since the age of 10! He was making receivers for sale by the age of 12 and was in business a few years later, in his own words "repairing anything with wires", branching out into TV and building amplifiers, using the trade name WADAR. However, in 1973, after 25





***Top:** Several sections of the Wells collection are dedicated to one brand; this section is devoted to Philco, which originated in the US but later expanded and produced receivers in countries such as Britain, Australia and New Zealand. Many of their sets are on display.*

***Centre:** Gerald Wells in a corner of his extensive collection, surrounded by sets saved from destruction by factory employees who delivered them to him instead of to the local dump!*

***Bottom:** A corner of the Ekco display in the Wells museum. E.K. Cole Ltd was a pioneer in the use of moulded Bakelite cabinets, and often employed leading designers to create innovative*

years, Gerald's health and the business collapsed and during his recovery he started his museum, initially as therapy.

That this venture was most successful is very evident. Gerald has an international reputation for both his knowledge and extensive collection which, although concentrating on English made equipment, nevertheless contains many splendid examples of US and European sets.

As well as a large display of just about every major brand of valve radio made in Britain and Europe, there are numerous early crystal sets (very popular during the 1920's), historic BBC equipment and early TV receivers, including Baird mechanical scanning viewers.

## Historic house

Even Gerald's home, a suburban detached house, has historic radio associations. Purchased by Gerald's father in 1914, 23 Rosendale Road had been occupied by a pioneer: Mr A.R. Taylor, London's first radio amateur, 2AF. Gerald can recall the old aerials still being in position when he was a boy.

Now large portions of both floors of the house are occupied by his displays, and in the basement is a collection of some 40,000 valves! The Wells collection, together with excellent workshop facilities including woodworking machinery, has long since expanded out into several separate buildings at the rear of the property.

A dedicated and skilled technician, Gerald restores to 'as new' condition equipment that many enthusiasts would consider to be unsalvageable. Major re-

***Possibly the world's first radio-gramophone! A 1924 prototype hybrid which never went into production. The tone arm activated the large pleated diaphragm, which doubled as a magnetic speaker for the front-mounted receiver section — comprising a crystal detector and two audio amplifier stages.***

construction of relics is commonplace, even to rebuilding cabinets and making celluloid dial scales, complete with new printing. A huge range of spares ensures that few receivers cannot be repaired because of lack of components.

Gerald derives great pleasure in sharing his knowledge and facilities. Under his expert guidance, hobby groups ranging in age from youngsters to pensioners repair, restore and even build replica receivers and cabinets.

## Saved by the staff

Most of the major makes have their own dedicated room or areas, making the location of an individual model an easy matter. A unique display is the collection of McMichael receivers. McMichael was a much respected firm who had a display of their own distinctive models. As can happen, they were taken over by a major organisation who had no time or space for what they considered as unproductive history. To their eternal credit, when the staff were ordered to dump the old receivers, they did so — but at 23 Rosendale Road, not in the municipal tip as envisaged!

Over the years, the Wells Collection has acquired some very significant and unique pieces of equipment. One of the most impressive is the BBC's Television Standards Converter, used during the transition period when the pioneer 405 line system was being phased out in favour of the PAL 625 line system. Occupying two standard racks, it is not small, but is invaluable for live demonstrations of early TV receivers.

## Valve manufacture

One dedicated activity of Gerald and a group of students must be unique. They are in the process of making working historic valves! Gerald acquired a small valve-making plant, and duly set it up in a workshop. At the time of my visit, they were in the process of making working replicas of the World War I French designed 'R' valve, a spherical bulbed general purpose triode with a tungsten filament. There were still a few minor problems to be ironed out, but I imagine that by now these have been solved.

Gerald is a very friendly and hospitable host, and welcomes genuine visitors — but PLEASE phone or write first to make an appointment. Unless you have mastered the intricacies of London's number 2 bus routes, about the easiest way to get to West Dulwich is to take an underground train to the Brixton terminus of the Victoria line and then a cab from there.

A word of caution though. Like many large cities, London has security problems, and Gerald's collection, situated as it is in a suburban house, is very vulnerable. For this reason his home carries no identification and it is not publicised locally as a museum. Do not direct the taxi to the 'Vintage Wireless Museum', but specifically to 23 Rosendale Road.

## Group in Tasmania

Closer to home, I have received a letter and brochure from the Sound Preservation Association of Tasmania (SPAT), whose purpose is to preserve history in the form of recordings and early recording and radio equipment. An accompanying photograph shows a very attractive museum display of equipment of all kinds.

Founded in 1985, and with monthly meetings, they are clearly a well organised and very active society with a resource/research centre in Hobart.

Recently SPAT was made an agent for the National Film and Sound Archive, Canberra. For further information write to Mr John Wanless, 157 Wells Parade, Blackmans Bay. ❖

# 50 and 25 years ago...

*'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.*

## May 1943

**Remarkable exhibition:** One of the strangest exhibitions ever seen in London displayed 300 photos, which showed how scientists working in different fields use photography as a tool.

One of the most remarkable was that of the English scientist Dr W.F. Hilton, who used an electric spark lasting only a minute fraction of a second to photograph sound waves generated by the propeller blades of aircraft running at over 10,000rpm. The purpose of these photographs is to study the mechanism of noise made by running airscrews, to be able to design a really silent aeroplane.

**Penetrates fog:** A patent has been granted in Washington USA, covering a device to aid pilots lost in haze or fog.

Using infrared rays, which penetrate fog but are invisible to the eye, an image of the ground is received and changed into electrical impulses by a device similar to a television receiver. Here the impulses are re-converted instantaneously to a picture of the screen — a picture which can be viewed directly.

## May 1968

**Earth station:** Australia's first earth station for full-time commercial satellite communication was officially opened at Moree, NSW. An international television exchange between Australia and Japan was arranged to mark the opening. It is estimated that around 50 million people watched the program.

The Moree station provides commercial telecommunication services between Australia and surrounding countries in the Pacific region which have earth stations in operation. At this time, these countries are the USA, Canada and Japan. Hong Kong will follow in 1969.

**Laser trim:** The problem of out-of-tolerance resistors in integrated circuit packages may have been solved by US engineers, by using a laser beam to adjust resistance after manufacture.

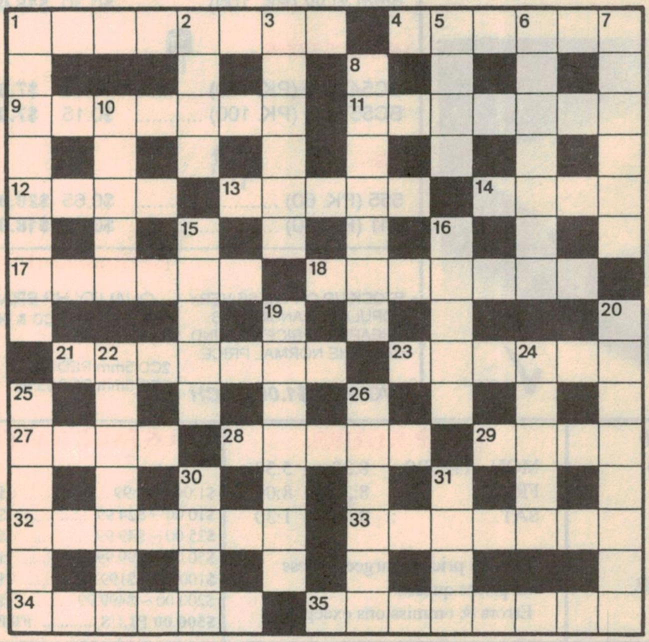
The engineers used an argon ion laser to 'zap' resistor elements by beaming the light through a glass lid. So far, the technique has only been applied to thin-film cermet resistors in linear ICs.

Using lasers to trim resistors isn't new in itself, but previously the package had to be open, because the shorting-bar technique required temperature cycling. This left the circuit susceptible to moisture and other kinds of contamination.

**Metric system:** The NZ Government has set up a committee to investigate the metric system of weights and measures, and to report whether the system should be adopted by New Zealand. Use of the metric system is already legally permissible, and has been extended into the field of building, architecture, engineering, medicine and pharmacy.

The Canadian Parliament has given the first reading of a a bill designed to study the applicability of the metric system to Canada. If in favour, a commission will recommend methods and a timetable. ❖

# EA CROSSWORD



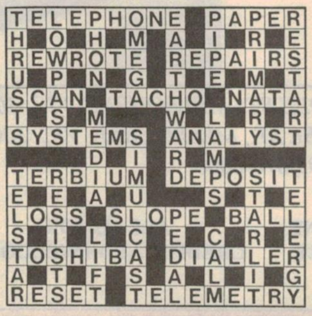
### ACROSS

1. Technical profession. (8)
4. Instruction book. (6)
9. Said of certain liquid crystals. (7)
11. Tram's electric contact wheel. (7)
12. Information in a message. (4)
13. Fuses. (5)
14. Not dangerous. (4)
17. Blended with foreign atoms. (6)
18. Temperature. (7)
21. Said of radiation effecting chemical change. (7)
23. Communication device, the —— phone. (6)
27. Structure with exposure control. (4)
28. Possible state of video tape. (5)
29. Prefix indicating transmission at a distance. (4)
32. Displays recorded signals. (7)
33. Such was Charles Kingsford Smith. (7)
34. Housing on aircraft or vessel. (6)
35. Button that operates a ringer. (8)

### DOWN

1. Famous theoretical physicist. (8)
2. Pure sound. (4)
3. Formed surface pattern. (6)
5. Fundamental particle. (4)
6. Removes cassette. (7)
7. Old electric storage device, the —— jar. (6)
8. Radio base. (7)
10. Confusion at the console? (3-2)
15. Path of planet. (5)
16. Charged particle. (5)
19. One who plays the viola. (7)
20. What usually precedes development? (8)
22. Crushed for security. (7)
24. Said of gas in a globe. (5)
25. Part of some galvanometers. (6)
26. Opposite to 14 across. (6)
30. Raise temperature. (4)
31. Panel showing time, etc. (4)

### SOLUTION FOR APRIL 1993



# EA with ETI marketplace

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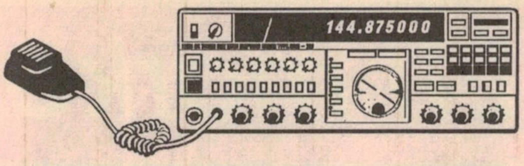
# Amateur Radio News




## Radio in balloon attempt

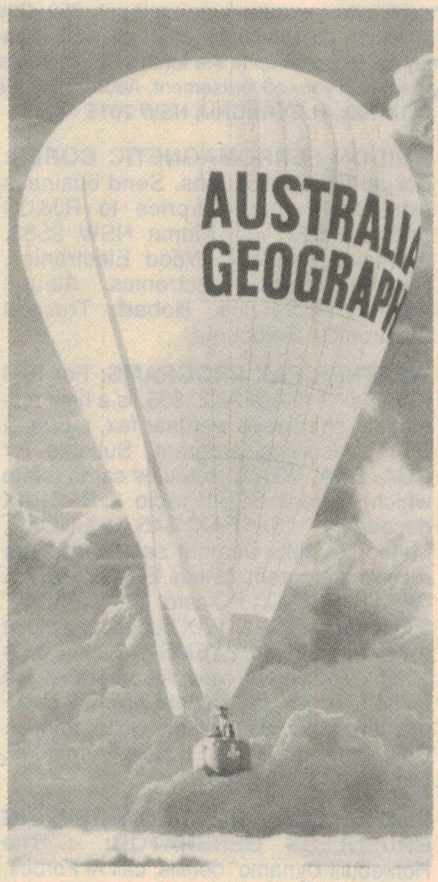
Radio communications and satellite navigation will be playing a key role in Dick Smith's *Australian Geographic* Transcontinental Balloon Attempt, planned for late May or early June. Dick and co-pilot John Wallington aim to make the 4000-kilometre crossing in three days, flying at between 10,000 and 18,000 feet.

The balloon will be ready for take-off from Carnarvon in WA on May 31, but the flight won't begin until the Bureau of Meteorology says that weather conditions are favourable. Bureau computer predictions suggest that June offers the best chance of success, but the outcome is still far from certain. Six previous attempts have failed to cross the continent, with the greatest distance covered to date by Julian Nott and 'Spider' Anderson in 1984, when they reached western NSW.

"It's this element of chance that fascinates me," said Dick. "Balloon pilots can't steer their craft accurately, and theoretically we could end up anywhere — as previous attempts have shown."

The attempt will be based on a combined Helium/hot air balloon, of the type invented by French pioneer Pilatre de Rozier in 1785. The actual balloon has been designed and built by English ballooning expert Don Cameron, and has a volume of 2970m$^3$.

It uses a high-tech gondola built from lightweight Kevlar, reinforced with carbon fibre, and is fitted with state of the art communications and navigation facilities —




including a GPS satellite navigation receiver, satellite data transmitter and receiver, radar transponder, and both HF and VHF transceivers.

*Australian Geographic* is setting up a 24-hour operations control centre at its Terrey Hills headquarters for the duration of the attempt, to supply information to all interested parties regarding the balloon's current position and status. The centre can be contacted by ringing 0055 29060 (25 cents for 42.9 seconds, from anywhere in Australia). An amateur radio station will also be set up at the control centre, in conjunction with Dick Smith Electronics and using a special callsign.

Dick Smith himself will be using callsign VK2DIK in the balloon, and probably working on twenty metres, with a likely frequency of 14.146MHz. Radio amateurs are invited to contact both the control centre station and the balloon during the attempt.


***A view inside the covered concourse area at Wyong's racecourse, taken during the Gosford Field Day. There were many trader's stands in this section.***

## Success at Wyong (Gosford)

This year's change of venue seems to have paid off for the Central Coast Amateur Radio Club's annual Gosford Field Day, because over 2000 people turned up at the Wyong Racecourse — a mere 200m or so from the station. The weather was very favourable, and a pleasant day seemed to be had by all.

Displays were mounted by many amateur radio clubs and organisations, including the WIA, WICEN, ALARA, AAPRA, ANARTS, the Gladesville Amateur Radio Club, the Central Coast ARC itself and the Castle Hill Military Radio Collection. A very impressive display of home-brew amateur TV gear was also presented by the very active Australian Amateur Television Club, formed only in 1991, while the CCARC's TV group was demonstrating an experimental four-hop ATV transmission over some 93km, using the 3.5GHz, 576MHz and 1.2GHz (twice) bands. The picture quality was most impressive.

Needless to say many traders also had stands, mostly under the Racecourse's covered concourse. Among those noted were Icom Australia, Dick Smith Electronics/Yaesu, Oatley Electronics, RCS Radio, Tech-Rentals, AV-Comm, VideoSat, Stewart Electronics and Emtronics. Both AV-Comm and VideoSat had demonstrations of satellite TV reception.

Also well patronised were the traditional 'boot sale' stands, which were present in larger numbers than in previous years. Other events included demonstrations of recent products by the main distributors, workshops on microwave and packet radio operation, both pedestrian and mobile fox hunts and the time-honoured disposals sale.

All in all, it gave every evidence of being the most successful 'Gosford' field day for many years. Congratulations to the Central Coast ARC for all of their efforts. ❖

Electronics Australia's

# Professional Electronics

S·U·P·P·L·E·M·E·N·T

**SYDNEY DEMO OF MPEG-1 DIGITAL VIDEO COMPRESSION SYSTEM**

**REVIEW OF LOW COST VIDEO & COMPUTER MONITOR TESTER**

**USING A VIDEOCAMERA & FRAME GRABBER FOR SCANNING IMAGES**


**NEW HANDHELD RF POWER METER FROM MARCONI MEASURES DOWN TO 0.1nW, FROM 30kHZ UP TO 46GHZ**

# NEWS HIGHLIGHTS

## SYDNEY DEMO OF MPEG BY SATELLITE

Sydney's media, along with representatives of Optus and potential Pay-TV service providers, were able to see for themselves the MPEG-2 digital video compression standard in operation at a recent demonstration given by Scientific-Atlanta.

MPEG-2 is one of the two digital video compression standards established by the ISO's Motion Picture Experts Group, and is currently favoured for international use in pay-TV, domestic digital video recording, video mail, digital video editing and computer-based video.

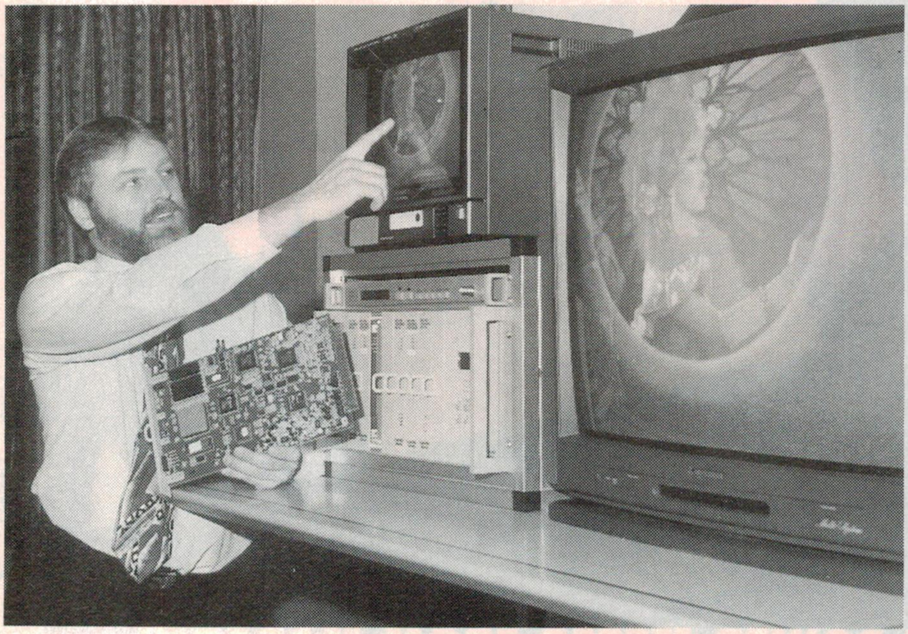
The Sydney demonstration involved a high quality ABC sports programme, the video of which was fed through one of S-A's MPEG-2 codecs to produce 8Mbps compressed digital video. This was then beamed up by Optus to a transponder on its low-power A3 satellite, and returned via the satellite's South-East beam.

A 75cm dish on the verandah of a hotel suite in North Sydney was then used to feed the signal to a satellite receiver and a four- channel 'commercial grade' MPEG-2 decoder/decompressor, producing standard PAL signals which were fed to monitors. The accompanying sound was encoded via the SEDAT (spectrum efficient digital audio transmission) system, as MPEG-2's sound format has not been agreed upon at this stage.

The received picture quality was excellent, and generally indistinguishable from studio-quality PAL. The performance of the S-A MPEG system was also very impressive in a later transmission of a technical tape with video clips specifically designed for rigorous testing of digital compression systems.

Scientific-Atlanta's codecs use MPEG VLSI digital compression chips from US firm C-Cube Microsystems, and have been selected by Viacom Inc for the Showtime and MTV multi-channel digital pay-TV networks being deployed in the USA this year. S-A also expects to have a VLSI chipset suitable for a set-top domestic satellite receiver and MPEG decoder, available before the end of the year. Scientific-Atlanta's MD Steve Dean said he expects the price of a complete satellite receiving setup for MPEG digital pay-TV to cost less than $1000, including dish and LNB but not the basic PAL TV receiver or monitor.

Other firms known to be developing decoder chips or chipsets for MPEG compressed digital video are General Instrument Corp, AT&T, Thomson Consumer Electronics, Philips, Compression Labs Inc and News Datacom. Dr Wayne Knowland, Optus' Director of Business Development, said that similar satellite tests with some of these suppliers are expected later this year.



*Managing director of Scientific-Atlanta Australia, Mr Steve Dean, demonstrates the benefits of MPEG digital Pay TV.*

## LOCAL FIRM TO MAKE 100MBPS LAN CARDS

Micro Focus, based in Asquith NSW, has announced that it will shortly be manufacturing locally a 100Mbps networking card for IBM-compatible personal computers, developed by a partner company in the USA. Known as the Plus-Net-100, the card allows high-speed data communications over existing copper cabling, between as many as 65,534 workstations.

Maximum single-station throughput available with the PlusNet-100 system is 7500kB/s for an EISA or MicroChannel system or 4000kB/s for an ISA system, using Novell's Perform3. Packet buffer size is up to 8K. The card has a 'half card' form factor and is equipped with a BNC connector for co-axial cable and RJ45 and RJ11 connectors for use with STP, UTP or Modular cables.

Cable segments can be up to 200m total using coax or STP, and up to 100m using UTP/Modular. Further information on the card is available from Micro Focus, phone (02) 476 5944.

## QLD FIRM MAKING TOROIDAL XFORMERS

Queensland firm Torema Australia is now manufacturing toroidal transformers under licence from a Swedish company. The company has invested over $100,000 in manufacturing plant, enabling it to produce complete toroidal transformers including the core.

Torema's design engineer Robert Marschner went to Sweden for comprehensive training of the design and manufacture of the transformers, and says that his company can produce toroidals with ratings from 15VA to 2000VA, and in any desired shape. A range of off-the-shelf models is also available.

Further information is available from Torema Australia, Helium Street, Narangba 4504; phone (07) 888 1277, fax (07) 888 3838.

## MITSUBISHI/TETIA SEMINAR 'BIG SUCCESS'

At the invitation of the Tasmanian Division of The Electronics Technicians Institute of Australia (TETIA), a training team from Mitsubishi Electric AWA visited Hobart on the weekend of March 13-14, to conduct a two-day technical seminar. The seminar was held at the Wrest Point Hotel Casino's Convention Centre in Sandy Bay, and was designed to provide the opportunity for technicians to update their knowledge and upgrade their skills with respect to the latest generation of consumer electronic devices.

The enthusiastic and hard-working Mitsubishi team consisted of Ruben Ferrero, the company's NSW Service Manager, with Training Officer Bert Ferreira and Senior Support Managers Stewart Parker and Brad Smith. The products and subjects they covered included CD players, fax machines, the latest 'digitally enhanced' colour TV receivers, VCRs, microwave ovens and cellular mobile phones.

All seminar attendees were provided with well prepared and very informative technical notes (prepared locally by the Mitsubishi AWA team itself), covering and expanding upon the subject of each session — plus a good deal of additional material as well. Many of the sessions were also enhanced with pre-recorded video and audio material, while video cameras and large-screen CTVs were used very effectively to provide real-time video enlargements of servicing technique demonstrations which involved compact equipment.

Some 42 technicians attended the seminar, many travelling to Hobart from as far afield as Western Australia and Queensland, specifically to attend. Included in the attendees were Mr Herman Scheper, Federal President of TETIA, and Mr John Donovan, the organisation's Federal Treasurer — both from NSW. *Electronics Australia*'s own editor Jim Rowe was also invited to attend, and gave a short talk on the Saturday evening.

All of those present at the seminar agreed that it was a great success, due largely to the energy and initiative of Ruben Ferraro and his team. Many people also paid tribute to Jim Lawler and Cliff Townsend of TETIA's Tasmanian Division, for all of the work they too had put into organising and planning the seminar. The Wrest Point Hotel Casino also came in for favourable mention, for the excellent convention and accommodation facilities it provides for such functions.

Mitsubishi Electric AWA has been conducting this kind of training seminar for about eight years, and is one of the few firms who provide a well-planned training program for independent servicing technicians.

## VET HAS CURE FOR 'DUDLEY' VIRUS

Recently it was reported that considerable disruption occurred within many of Telecom Australia's offices, due to infection of its personal computers by a hitherto-unknown virus which identified itself with the message '[Oi Dudley!][PuKe]'.

The virus apparently infected all .COM and .EXE files that were opened, renamed or accessed in any way, and appended itself to them — increasing their length by between 1200 and 1250 bytes. It was reported to cause no intentional damage, but triggers viral detection software and causes crashing of the Windows GUI.

Although Telecom's US-sourced antiviral software could detect the new virus, it was apparently unable to disable it and recover infected files. However Melbourne antivirus expert Roger Riordan and his team at Cybec came up with a full antidote in less than 48 hours after receiving a sample copy, maintaining their record for fast response.

Cybec's latest Version 7.22 of their popular VET antivirus program has incorporated full protection against Dudley, as well as recovery of infected files, and now offers protection against a very wide range of computer nasties.

Further information is available from Cybec on (03) 521 0655.

## OOPS — SORRY!

Due to an unfortunate error in our production department, the wrong artwork was used for quartz crystal manufacturer Hy-Q Electronics' advertisement on page 121 of our March issue. The artwork used showed Hy-Q's former address in Frankston, not its new address in Clayton.

When the March issue was published, apparently the firm received many enquiries from readers wanting to know if they had moved back to their former premises — embarrassing, but at least it showed that advertisements in *EA* produce a good response!

However we must apologise to Hy-Q for the mistake, and to set the record straight the firm's correct address is 17 Winterton Road, Clayton Victoria 3168; phone (03) 562 8222; fax (03) 562 9009.

## NO IMPROVEMENT IN 'OZONE HOLE'

Continuing observations by the Nimbus-7 and Meteor-3 Total Ozone Mapping Spectrometer (TOMS) instruments have confirmed that the depletion of stratospheric ozone over Antarctica in 1992 was as severe as any previous year.

In 1992, the 'ozone hole' developed one to two weeks earlier than prior years. NASA scientists at Goddard Space Flight Centre,Greenbelt, Md., also have confirmed that on September 23, 1992, the Antarctic ozone hole was the largest on record. On that date, the surface area of the ozone hole reached 8.9 million square miles (24.35 million sq kms), but fell to less than 7.7 million square miles (20 million sq kms) in October. For comparison, the surface area of the North American continent is 9.4 million square miles.

This past year's Antarctic ozone depletion was comparable to the 1990 ozone depletion in duration and depth, NASA scientists report. The 1992 ozone hole breakup began in early December, later than the normal November break-up.

## NEWS HIGHLIGHTS

## HPM OPENS NEW MOULDING PLANT

Leading Australian manufacturer of electrical accessories, HPM Industries has completed a $22 million state of the art plastics moulding plant in Sydney. The plant was recently opened by Senator the Hon. John Button, Minister for Industry, Technology and Commerce, who praised HPM for its continued support of Australian manufacturing.

Mr Peter Simon, AM, managing director of HPM, said the commissioning of the plant is the culmination of more than five years work and represents HPM's continued commitment to 'Australian-made, Australian-owned' products.

"This is the most technologically advanced plastics moulding plant in the Southern Hemisphere for engineering plastics. While other companies have taken their manufacturing offshore, we are committed to keeping manufacturing in Australia. This means keeping jobs and money here at home," said Mr Simon.

The moulding plant, located in Lachlan Street, Waterloo, Sydney, operates 24 hours a day and produces over 1.5 million mouldings each day.

Raw materials are stored on the site and automatically transferred to the moulding machines, which produce the moulded parts. These parts are then conveyed automatically, directly into containers, or to work stations where they receive second operations and are finally packed. The produced mouldings are then stored in a computer controlled bar-coded store and shipped on a daily basis for HPM's assembly production needs.

The plant can accommodate up to 100 moulding machines and is designed so that all machines can be fed material from an automatic material transfer system which is vacuum-driven.

Almost $250,000 has been spent ensuring an adequate electricity supply for present and future equipment, including a 1.5MVA transformer which was fitted on site providing a 2000 amps capacity per phase. During the last two years, HPM has adapted 'Rapid Prototyping Technology'.

"This latest technology makes use of computer algorithms, unique photopolymer plastics and the latest technology in laser beams, and has immediately given HPM Industries a 30% improvement in the time taken in getting new products to market," Peter Simon said. Research now being undertaken could improve this efficiency gain a further 50% during the next 12 months.

According to Mr Simon, due to HPM's experience over the last two years in this leading edge technology, the company has been invited to participate in the worldwide 'Intelligent Manufacturing Systems' investigations.

## 33KV SUBMARINE CABLE FOR SA

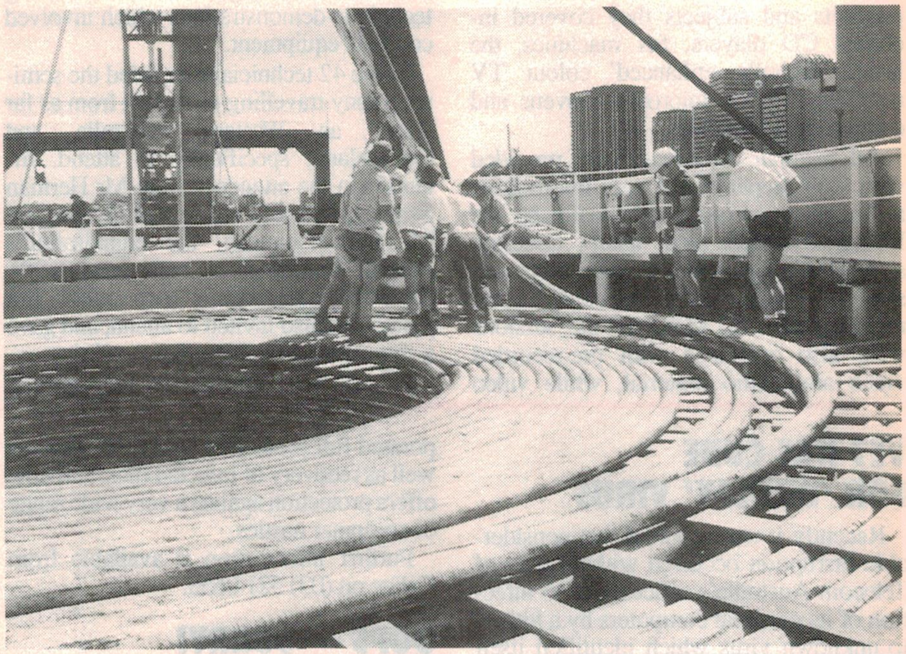
MM Cables, a member of Metal Manufactures Group, recently installed the first locally manufactured 33,000V submarine cable in Australia, which will be used to supply power to South Australia's Kangaroo Island.

MM Cables was awarded the contract last year, by the Electricity Trust of South Australia (ETSA) for the manufacture and installation of a submarine cable to supply power from the South Australian mainland to Kangaroo Island.

Kangaroo Island has been connected to the mainland by a submarine power cable since 1965, but recently, abalone divers discovered that the outer protective armouring was deteriorating rapidly due to corrosion. The new cable is designed for a 40-year life, with a total capacity of 10MVA transmitted at 33kV, which will be sufficient to supply any future developments on the island.

The cable consists of three cores which are 50mm$^2$ compacted copper conductors insulated with cross-linked polyethylene (XLPE) applied as a triple extrusion of semi-conductive conductor screen, insulation and semi-conductive insulation screen. Each core is enclosed in a lead sheath to provide a metallic moisture barrier and then covered with a protective layer of PVC.

The three cores were laid together to form a cable assembly and several layers of mechanical protection were applied to protect the cable from the harsh environment of the sea bed. The total length of the cable is approximately 15km. It was manufactured as twenty lengths which were jointed on the wharf prior to being loaded on the cable laying vessel.



## TEKNIS TO SUPPLY RFDS CONTROL SYSTEM

The Royal Flying Doctor Service has signed a contract with SA communications specialist Teknis Electronics to install the RFDS's first computer-based centralised control system for remote radio base station operations.

Under a $250,000 contract, Teknis will provide three of the RFDS's remote bases in central WA with their first 24-hour link to the Service's main operating centre at Perth's Jandakot Airport. The contract will be the first infield application of Teknis's upgraded TRCS9000 telemetry system.

Teknis has already carved a niche market in remote area communications with aviation authorities in Australia and Papua New Guinea with its TRCS16 telemetry equipment.

Switching gear to be installed by Teknis at each of the RFDS's bases at Carnarvon, Meekatharra and Port Hedland will allow calls to these bases when they are unmanned, to be received automatically at the RFDS operations room at Jandakot.

These calls currently have to be channelled to the RFDS via remote area police stations or hospitals — a more time consuming exercise.

The contract includes the installation of three touch-screen monitors and 32 audio channels at Jandakot — with a capacity to expand the number of monitors if required, to 14 consoles and 160 audio channels.

## FREE TRAINING COURSES ON PLC'S

Siemens is offering industry free, one day training courses on its Simatic programmable controllers (PLCs). The courses, available in the main capital cities, are aimed at end users, OEMs, software houses and systems integrators.

Josef Kroell, Siemens Manager, Industrial Automation department, explained the courses gave potential clients an opportunity to try before they buy new PLCs. "The courses involve a practical program that focuses on hands-on learning," he said. "They are specifically designed for people who have not previously used Siemens equipment."

Siemens offers two ranges of PLCs, the Simatic S5 and Simatic TI lines. The company is able to provide comprehensive courses for both, either in its own training centres in various States or on customer premises. It also has a strong service team to support the equipment.

Companies interested in sending employees to one of the Siemens free courses should fax Wolf Hannemann on (03) 420 7500.

## NASA AWARDS MEDAL

Gene Roddenberry, creator of the Star Trek television series, has posthumously received NASA's Distinguished Public Service Medal.

The medal was presented to his widow, Majel Barrett Roddenberry, by NASA Administrator Dan Goldin in a ceremony at the Smithsonian's National Air and Space Museum in Washington, D.C.

Roddenberry is credited with popularising the exploration of space through the original Star Trek television series, six motion pictures and the spin-off television series Star Trek: The Next Generation.

His vision of a positive future for the human race, as well as the social and artistic content of the series, have enjoyed enormous success and popularity since the original Star Trek premiered on television in 1966.

The citation accompanying the medal reads: 'For distinguished service to the Nation and the human race in presenting the exploration of space as an exciting frontier and a hope for the future.'

Gene Roddenberry died in October 1991.

## NEWS BRIEFS

- The 18th Australian conference on optical fibre technology, ***ACOFT-18 '93***, will be held at the Northbeach Parkroyal Hotel, Wollongong NSW, from Sunday November 28 - Wednesday December 1, 1993. Original papers are solicited for the conference, with a closing date of August 27. For more information contact IREE Head Office, PO Box 79, Edgecliff 2027; phone (02) 327 4822, fax 362 3229.
- ***Marconi Instruments*** has appointed Lee Moyle and Paul Coulton as its new Victorian and Queensland Sales Engineers. The address of Marconi's new Brisbane offices is: Suite 4, Level 1, 895 Ann Street, Fortitude Valley 4006; phone (07) 252 3877, fax 252 2924.
- ***Alcatel Data Networks*** is a new joint venture between Alcatel and Sprint. The new company will be a world supplier of systems for public and private wide area data networks.
- ***Autodesk Australia***, famous for its CAD package, is relocating its head office from Melbourne to Sydney in June 1993. It is currently seeking office premises on Sydney's North Shore.
- Mr Brian Cridland has been appointed Managing Director of ***GEC Australia***, which is the parent company of the Australian operations of the Marconi Instruments and GEC Electronics divisions.
- Australia's International Engineering Exhibition, ***AIEE'93*** will be held at the Royal Exhibition Building, Melbourne, from May 31 - June 4, 1993. This 25th anniversary event will showcase the latest technology from around the world. For more details contact Thomson World Trade Exhibitions; phone (02) 357 7555, fax 357 3020.

## 'FATHER OF ROBOTICS' FOR BRISBANE CONFERENCE

Mr Joseph Engelberger, regarded as the father of robotics, is one of many leading experts coming from around the world to Brisbane in July to address an international conference called ROBOTS FOR COMPETITIVE INDUSTRIES.

The conference will explain how new technologies such as machine vision, platform mobility and water-jet cutting have made robots profitable for many industrial applications beyond the classical manufacturing uses.

Robots for agriculture, food, health and retirement care, cleaning, construction, mining and security industries will be discussed at the conference, as well as applications in manufacturing and assembly.

Mr Michael Kassler, National Co-ordinator of the Australian Robot Association which is organising the conference, believes the new applications have great significance for Australia as the country's economic strengths lie primarily in non-manufacturing industries such as agriculture, banking, construction, health care, mining, retailing, tourism and other services.

"Australia's largest manufacturing sector is food manufacturing which has different automation requirements to the metals industry for which the classical robot was designed," he said. "Robots are increasingly valuable to Australia and we will see more them here in the next decade to paint buildings, pick fruit, shear sheep, perform surgery, cut food, vacuum floors and deliver meals."

The ROBOTS FOR COMPETITIVE INDUSTRIES conference will be held at the Sheraton Brisbane Hotel from 14 to 16 July. Registration forms are available from the Australian Robot Association, GPO Box 1527, Sydney NSW, 2001.

## QUALCOMM REVEALS HANDHELD CDMA PHONE

At the US Cellular Telephone Industry Association's (CTIA) Annual Conference in Dallas, QUALCOMM Incorporated unveiled the industry's first handheld, dual-mode, CDMA/analog portable phone.

The new phone, designated the CD-7000, can operate as a digital Code Division Multiple Access (CDMA) phone wherever CDMA service is available, and otherwise as a high quality standard analog cellular phone.

"In designing the new CD-7000, one thing was paramount. Use every technological advantage available to produce an instrument that delivers the best quality and advanced features to the user. That's what the CD-7000 is... the finest digital portable you can buy," said QUALCOMM CEO Dr Irwin M. Jacobs.

When operating in the CDMA mode, the dual-mode portable phone offers exceptional voice quality and area coverage while transmitting RF power at output levels significantly lower than analog mobiles. Using its unique power-control circuitry and the CDMA signal technology, the CD-7000 need transmit only one twenty-fifth to one thousandth as much power as typical analog phones, Jacobs added.

The new portable measures 7" x 2-1/4" x 1" and weighs just over 12 ounces. It offers over two hours of talk time and over 24 hours of standby time with its extended life battery, or over 60 minutes of talk time and over 12 hours of standby time with its slimline battery. The portable accesses 832 FM channels and an equivalent 8000 to 16,000 channels in the CDMA wideband mode.

The CD-7000 will be available in production quantities by late 1993. ❖

# Monitor tester from Black Star

UK test equipment maker Black Star now has available a microprocessor-controlled pattern generator which can be used to test video monitors. Fourteen different types of monitor can be tested, from monochrome 'TV' types to full colour SVGA computer models.

This new video monitor tester is the model 1410, which can be used to align and test both computer and TV monitors and video projectors. The comprehensive range of line and frame frequencies, together with the variety of rear panel outputs, allows it to operate with the majority of commonly used computer monitors, including those used with the IBM PC and compatible computers.

Ten different test patterns are provided for each of 14 different systems. The patterns include a standard test card, border, horizontal and vertical lines, dots and grating, checkerboard, focus, raster and colour bars.

The 14 standard systems vary from TV (with a 15.625kHz line frequency and 50Hz field frequency) to 768-line SVGA (with 48.5kHz and 60Hz). The unit is programmed for the following systems, listed in increasing line frequency: two TV systems (the second has 250 lines), CGA (with and without border), MDA/Hercules, PGA (400 and 480 lines), VGA (350, 400 and 480 lines), SVGA (600 lines), 8514A/XGA (384 lines) and SVGA (768 lines).

For all systems except MDA/Hercules, primary red, green and blue signals are provided (with secondary red, green and blue for EGA).

Each colour can also be inverted. TTL signal amplitude is provided via the 'Digital' 9-pin D socket, for EGA and lower line frequencies; while the analog colour (PGA, and higher) can be accessed via either the appropriate 9-pin or 15-pin D socket or three BNC sockets. With the analog colour, the intensity of each of the three primary colours can be varied, and can be switched to either a 1V or 0.7V maximum.

Frame sync and composite sync also are available at two other BNC sockets, while all sync signals can be set to normal or inverted.

The analog colour can also be displayed in an increasing intensity pattern down the screen, by selecting the 'ramp' option.

## How it performed

The 1410 tester is very easy to use. A 16 x 2 character LCD shows either which system, or which pattern within a system, has been selected.

You make your selection by pressing the 'S-P' button, which toggles between system and pattern. With system selected, you use the up and down arrows to cycle through the stored systems, until you find the one that matches your monitor. Then you press the S-P button again, and cycle through the various test patterns for that system. You can now use the screen image to adjust or align the monitor being tested.

There are a few special controls which are only active for some monitor types. For example, the 'I' (intensity) button is only used for CGA models, and the secondary colours (R', G' and B') for EGA. As mentioned above, the variable intensity only works for analog colour. The supplied manual clearly lists which settings are appropriate for each type of monitor.

It is obviously assumed that anyone using this monitor tester knows how to use each pattern for testing and alignment — no information is given for the actual test procedures. Perhaps it would be a good idea to include an appendix in the manual, listing which pattern is best suited for which procedure? There seemed to me to be more patterns than required, so I would have appreciated knowing why each particular pattern had been included.

We tried out the tester on MDA, CGA, EGA, VGA, and SVGA (600 *and* 768 lines) — this high definition monitor was available because our sister publication *Your Computer* just happened to be reviewing one of the latest NEC products.

To test each display, we simply unplugged the monitor signal lead from the computer and plugged it into the 1410 tester. This worked perfectly for all but the EGA monitor — so we assume that this particular monitor lead did not have standard connections.

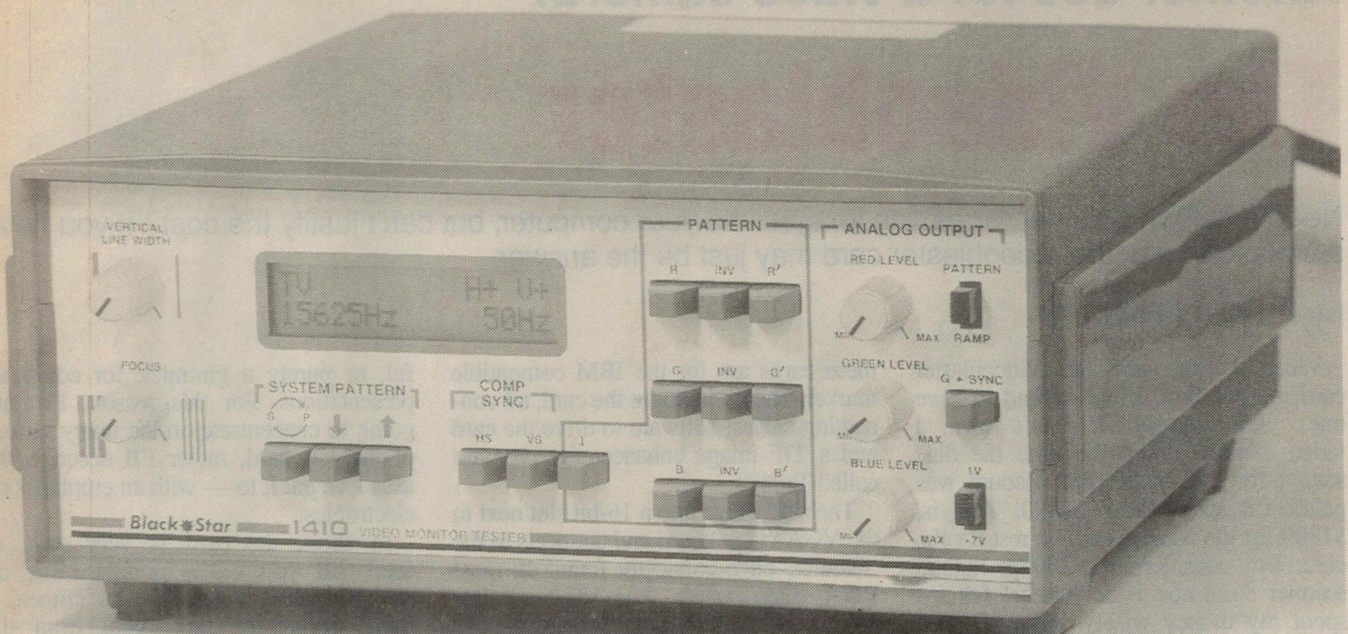
When this type of problem occurs, it can be easily solved by making up a simple patch cord, using the information given in the tester manual and that for the monitor to determine which type of signal should be present at each pin.

We also used the tester on a green-screen monitor with an RCA socket input. For use with such TV-type monitors, you take your output from the green signal at any of the analog outputs. We found it to be more convenient to connect to the BNC socket on the back of the tester, rather than to either of the 9-pin or 15- pin D sockets.

For this type of monitor you must activate the composite sync pulses. By depressing both the HS and VS buttons on the front panel, you ensure that both horizontal and vertical sync pulses are present. Then, when the 'G + SYNC' button is also depressed, these sync pulses are added to the green output signal.

## 'Special' models

In addition to the 14 standard systems, the 1410 can also cope with certain 'non-standard' video and sync signals by altering a set of DIP switches. As well as this, the 1410 can be factory preprogrammed (at extra cost) to cope with other non-standard monitors — to give, for example, different line/frame frequencies and/or sync polarities. Black Star has recently increased the maximum horizontal + vertical sync frequency from <=1024Hz to <=2048Hz,




to increase the number of monitors which can be tested.

It should be noted that these modifications cannot be made retrospectively, as the special systems are only programmed into new units at the factory. Also, adding a special system will take the place of one of the standard 14 usually supplied. Therefore, customers must specify which standard system they do not require.

## Inside the case

Four thin bolts hold together the top and bottom halves of the plastic case. An inspection inside quickly reveals the digital nature of the tester — the microprocessor, memory and logic chips sit on the main printed circuit board which covers the whole base area. There are also three smaller PCBs which are mounted vertically.

The various switch controls on the front panel are soldered directly to the first of these vertical boards, which is one of a pair mounted directly behind the panel. The third board is smaller, and is held by a bracket at the side. There is room for extra boards in this bracket, allowing for added features to be included in future models.

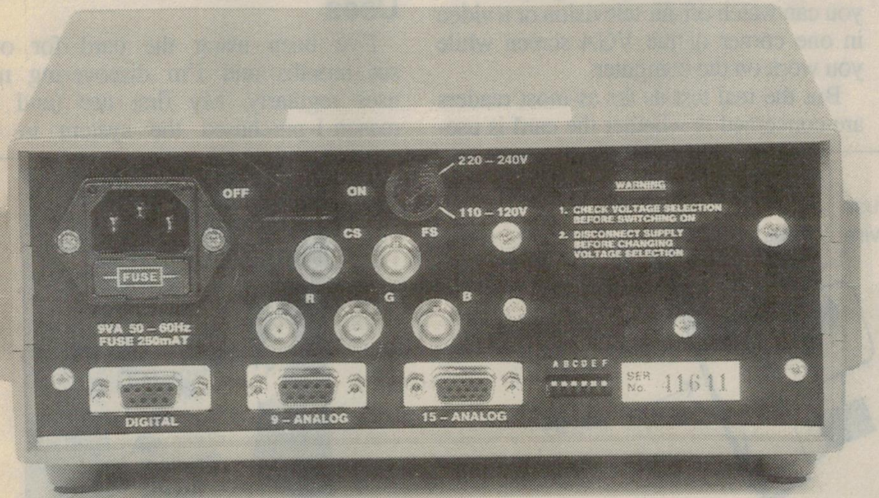
The whole setup is neatly arranged, giving easy access if any servicing or testing is required.

## Summary

The 1410 tester would be a very handy instrument for anyone involved in testing or realigning monitors. The various patterns cover all areas of adjustment, and the 14 systems included in the basic model cover the majority of monitor types. The tester itself is very light (2kg) and reasonably small (220 x 100mm, and 240mm deep), so it is easy to transport. The use of a microprocessor to generate various test patterns is becoming more and more common, and this fact is reflected in the appearance on the market of more lower-cost instruments like the 1410.

Black Star has also produced a software 'Testcard' program which allows the computer to draw all of the necessary standard test patterns for servicing IBM-compatible monitors. This package includes drawing a circle, which interestingly is a function not generated by the 1410! Apparently, a circle could not be included without additional cost. The Testcard software costs $115.

The price for the standard 1410 tester is $1438 ($1250, ex tax). The special models (factory preprogrammed for non-standard systems) cost $1775 ($1498). Both the monitor tester and the Testcard software are available from Obiat, 129 Queen Street, Beaconsfield 2015; phone (02) 698 4776, fax 699 9170. (P.M.) ❖




***There are various sockets on the back panel for the colour output, including both D-type and BNC for analog signals. The DIP switches can alter video and sync settings for non-standard monitors.***

## Another use for a video camera:

# The Videoblaster

Need a flatbed scanner for getting images into your computer, but can't justify the cost? If you have a video camera, the Videoblaster card may just be the answer.

**by PETER PHILLIPS**

When I first saw the Videoblaster card in operation, I knew I had to have one. Unfortunately, I didn't own a video camera so by the time the dust settled (or the credit card account was paid), I'd spent about $2400. That is, $1800 for the camera and the rest for the card. But considering a 300dpi flatbed scanner costs about the same, I felt I'd spent my money wisely. After all, you can't take videos of the kid's parties with a scanner!

Does this system produce the same results as a flatbed scanner? Basically yes, although it can do things a scanner can't. But first a few words about video capture cards.

### Video capture

Cards that capture the image from a video source are not new, and a project called the 'Frame Grabber' was described in *EA*, as far back as August 1989. What's new is the price.

These days a video grabber card for an IBM type computer costs less than $1000, and depending on where you shop, a Videoblaster card can be had for around $695, which compares very favourably to other brands. While this may still seem expensive, the card is complex and occupies the full length of the computer.

The Videoblaster card comes from Creative Labs, who are perhaps better known for their Soundblaster card. Both these cards are for the IBM compatible market. The kit includes the card, all connecting cables, software to drive the card and a TIF image enhancement program called Tempra.

The card plugs into a 16-bit slot next to the VGA video board and connects to the 'features' edge connector found on most VGA video boards. The VGA monitor then plugs into the VB card and all signals to the monitor are now via this card.

Like just about all video capture cards, the VB card only works with VGA (640 x 480), not SVGA (800 x 600). It's designed to run under Windows (although DOS drivers are included) and if you are set to SVGA (or higher), you'll need to change to VGA when using the VB card. This is relatively simple to do under Windows 3.1, as you don't need to exit to DOS as in Windows 3.0.

The card has three video inputs as well as stereo sound inputs and outputs. I've not used the sound capability, as in this case my interest is purely in images. You can therefore have up to three video inputs, with each one selectable via the software interface. An interesting twist is to connect the video output of a VCR to the card, and arrange the display size so you can watch off-air television or a video in one corner of the VGA screen while you work on the computer.

But the real test as far as most readers are concerned is whether the card is useful, or purely a gimmick for computer presentations. For this reason, I'm not going to concentrate on the many virtues of the VB card, rather I'll describe the uses I've put it to — with an emphasis on electronics.

In short, the card is very easy to use. All you do is double click on the Videokit icon, and up comes a frame containing the signal from the video source. The screen display is not far short of that from a conventional TV set (in full colour of course), and you can now adjust the focus of the camera and position the item you're photographing by simply watching the computer monitor.

There are a number of adjustments to set contrast, brightness and colours. Once everything is correct, select 'freeze' to capture the image. The image can then be saved to disk in one of several formats, including PCX, TIFF, GIF, BMP and so on. A TIFF image takes around 300k, so make sure you have room on the hard drive! Once the image is saved, the rest is up to you and the various image enhancement programs now available.

### Uses

I've been using the card for over six months and I'm discovering new uses regularly. My first use (and the reason I purchased the system in the

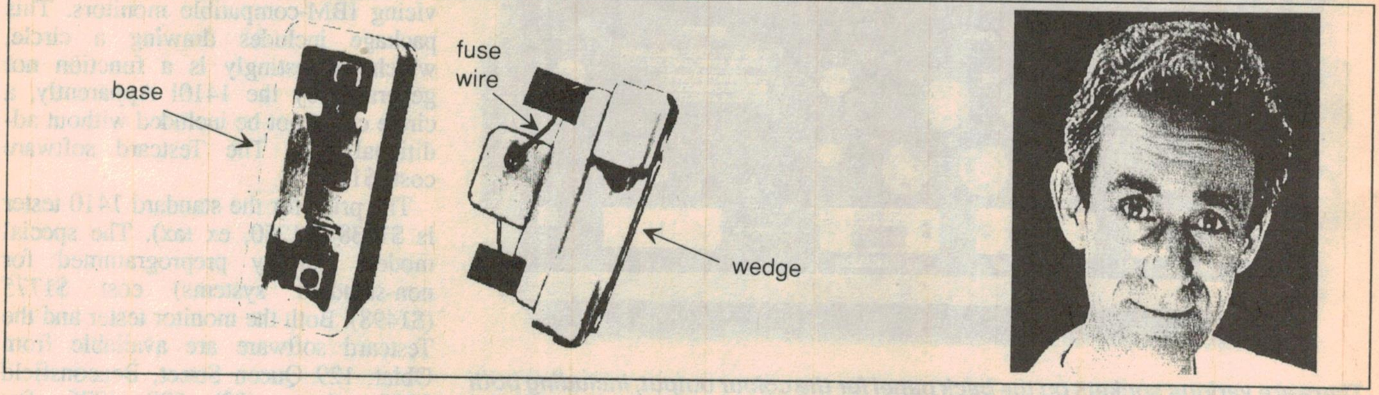



***Fig.1: Examples of captured images with an 8-bit grey scale are shown here. The printing process may have reduced the sharpness of the images.***

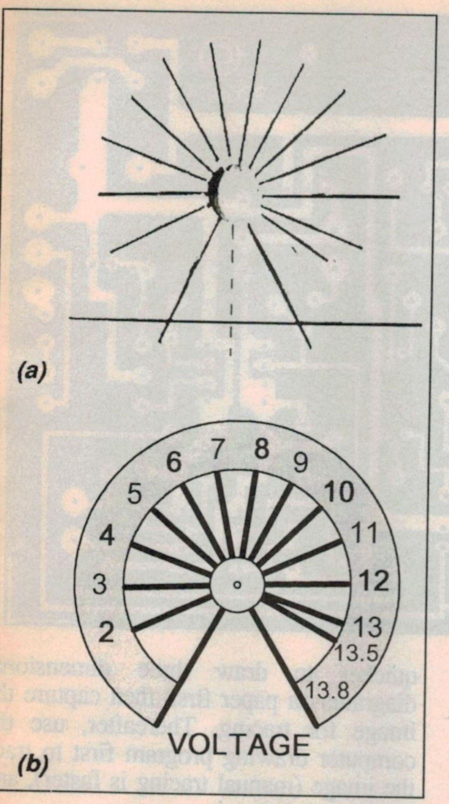


Fig.3: The computer drawn instrument scale in (b) was developed by tracing over the captured image of (a).

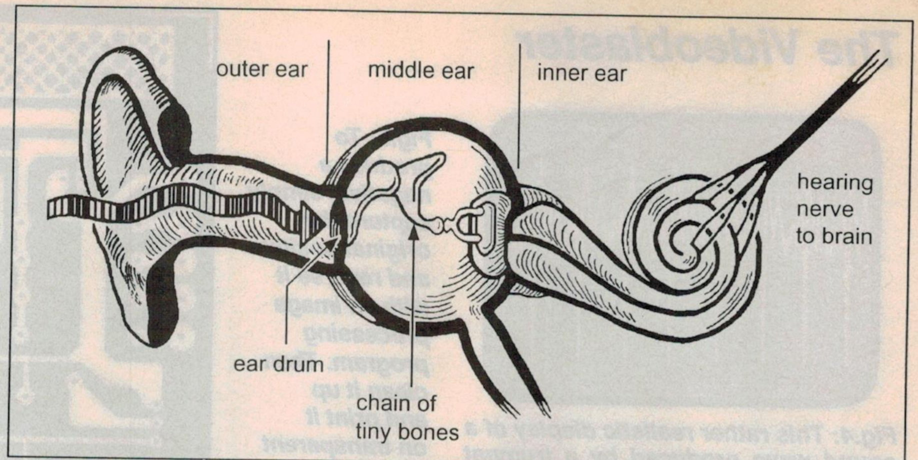


*Fig.2: This line drawing, captured from an original has been edited (and changed) in Tempra and the text overlaid in Ami Pro.*

first place) was to capture images to illustrate publications.

A word of warning here though. The quality of the printout is limited more by your printer than the camera/capture card. I don't know the dpi equivalent of the video capture system, but it certainly appears to exceed 300dpi.

The fuse carrier shown in Fig.1 was printed on a Linotronics 1800dpi typesetter, and the original has superb quality, equal to any black and white photo. The photo of yours truly was printed on a 600dpi Laserjet 4, and also has excellent quality. However according to one source, the random arrangements of the pixels within the images will cause loss of definition when they're 'screened' in? preparation for the printing press. So the images you're seeing are probably not as sharp as the originals.

Therefore, a typical use is to produce black and white photographs that can also be used in computer generated documents. For instance, take a photo of yourself and use it in your letterhead. And unlike a scanner, you can photograph 3D objects, or a whole scene. This can be useful in many ways, as it enhances any correspondence. Of course, if you correspond by disk, you don't even need to print the images — simply include them on the disk.

The next use is in capturing line drawings, rather than images with 256 grey tones. Here things are not as good as a scanner. This is more a function of the software, rather than the hardware. The software available for most scanners is quite sophisticated and allows images to be cropped, black and white levels to be set independently and so on. The software that operates the VB card has none of these features, although Tempra has the cropping facility. However, I've had quite a few successes, although the images sometimes need a fair bit of 'treatment' before they're ready for use.

The line drawing in Fig.2 was captured via the VB card, then doctored with Tempra. This program lets you 'pixel' edit a TIF file, and the doctoring required several processes.

In the first place, the image was enlarged in Tempra to give twice the original resolution. Then the rough edges were trimmed by deleting (or adding) pixels to give the final result. It took a lot of time, although I suspect a similar effort would have been required from a scanned image.

However, a 300dpi scanner would probably give a better delineation between black and white. A video camera doesn't have quite the same spread, and white invariably comes out as grey.

Also, the bandwidth of the camera affects the edges of a line, giving grey tones rather than solid black and white. A scanner is set to handle line diagrams and therefore scanned images are generally better than video captured ones. Still, with appropriate editing, the final result is just as good.

# The Videoblaster

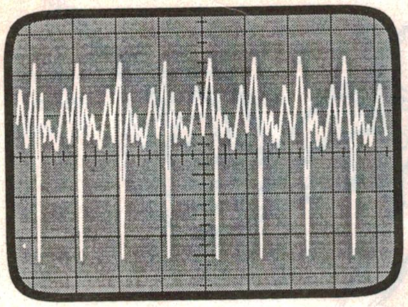


*Fig.4: This rather realistic display of a sound wave produced by a trumpet was developed by capturing an existing drawing of the waveform. It was then traced and the CRO screen added.*

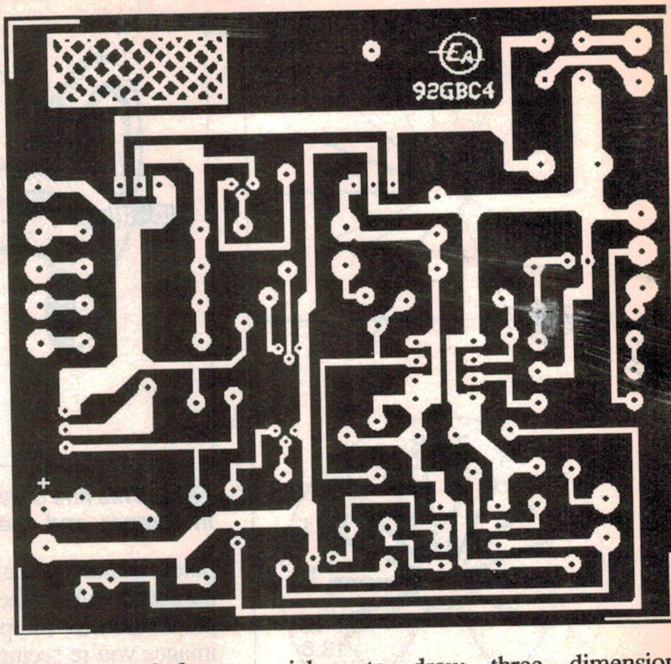


*Fig.5: To produce a negative, simply capture the original positive and reverse it with an image processing program. Then clean it up and print it on transparent film.*

Another use is to capture a diagram then trace it with a computer drawing program. For instance, I needed a front panel for a project, with a scale for one of the controls. I first obtained the scale manually by marking each setting on a piece of white cardboard. I then captured the drawing, imported it into a drawing program and produced the scale shown in Fig.3. The original captured image is also shown.

To enhance a document about sound, I needed a few waveforms of sounds from musical instruments. No problem. An obliging encyclopedia gave me the waveforms, my drawing program gave me the CRO screen. Otherwise I could have captured an actual CRO display — except I didn't have access to a trumpet. The result is shown in Fig.4.

Most people can sketch better with a pencil than a mouse, and I've found it quicker to draw three dimensional diagrams on paper first, then capture the image for tracing. Thereafter, use the computer drawing program first to trace the image (manual tracing is faster), and finally to enhance it.

A use I'm sure many readers would have is to produce a negative for a printed circuit board. Protel, like all PCB design packages only gives a 'positive', where tracks are black and the rest is white.

To get a negative, print out the artwork from Protel (or whatever PCB design software you use), capture it with the video camera, then reverse the image to a neg with Tempra or other image processing software. Then you can give it a bit of a clean up while you're in Tempra, and print the result on photocopy film on a laser printer. I've found this process works very well, and the time taken is not excessive. It would also work with taped artwork. An example is shown in Fig.5.

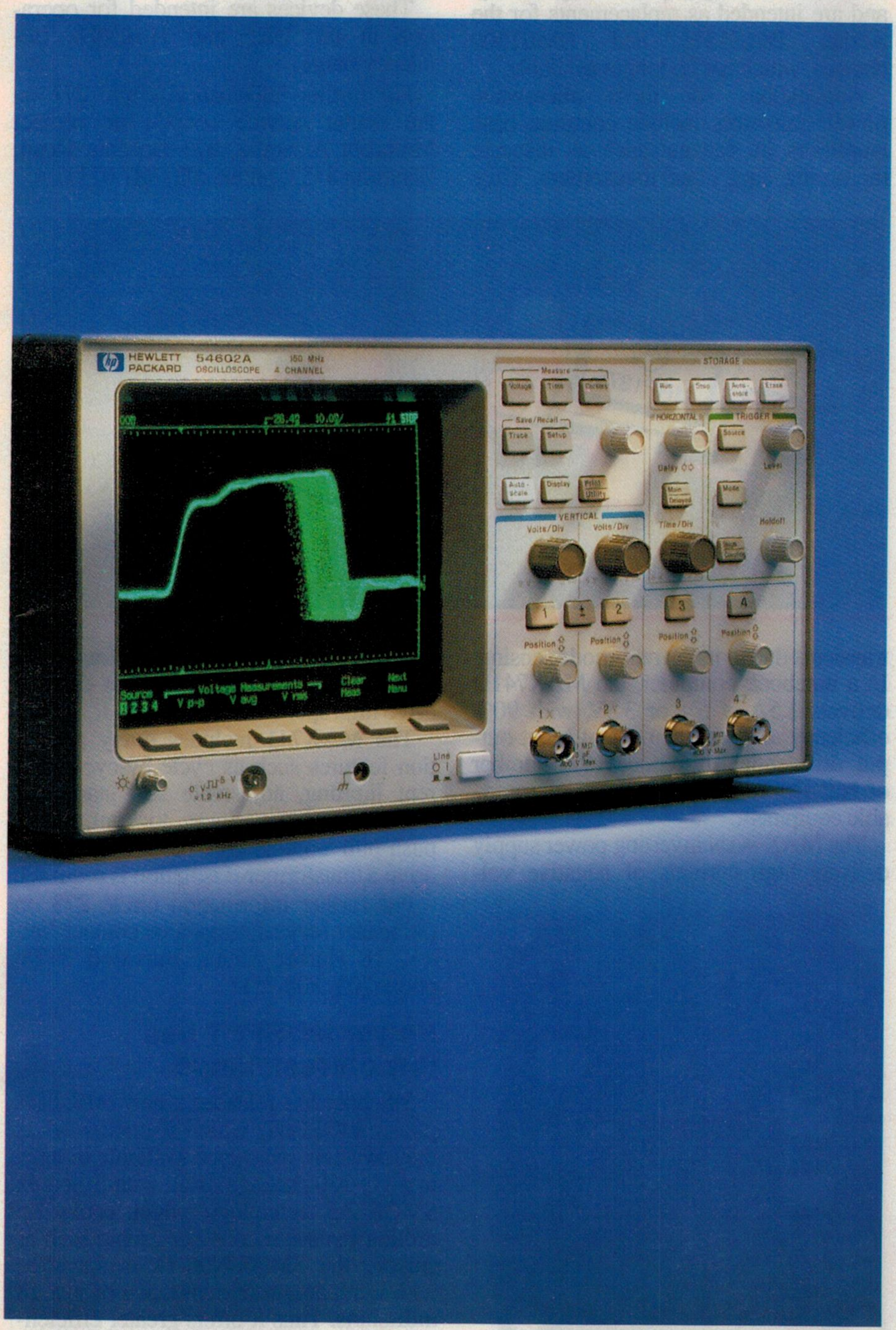
In summary, this system probably gives you more scope than a scanner, particularly where real-life objects are concerned. The better the video camera, the better the final result, and cameras with separate luminance and colour outputs (like S-VHS) will give a wider bandwidth and sharper images.

I've not mentioned other uses, such as preparing a computer slide show for a presentation, where each 'slide' is a photographed image. And there are no doubt many more uses that I've yet to discover.

The camera used to produce the diagrams in this article is a Sony Handycam, model CCD-TR75E. The Videoblaster card was supplied by Tectalk, who can be contacted on (02) 543 2764. ❖

FFT and a scope for under $5,500

# You Didn't Think You Could Afford HP, Did You? Think Again.

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**The value of this 100MHz scope is easy to see.**

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But what really stands out is that all this performance costs just **$4,840** (4-channel) or **$4,170** (2-channel).* What's more, now through June 30, 1993, you can add FFT by purchasing an HP 54657A or 54658A Measurement/ Storage Module **for only $625.**

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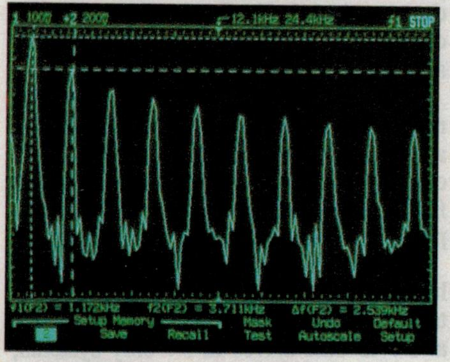



*FFT is just one of the advanced waveform viewing tools you'll get with the HP54657A/58A Measurement Storage Module.*

HEWLETT PACKARD

## ISDN transmission chips

Siemens has released two new transmission chips for the So interface. Both are based on the ISDN Subscriber Access Controller ISAC-S.

The PEB 2086 is an enhanced PEB 2085. It now has a balanced input circuit in the receive section of the So interface, which simplifies the external wiring and facilitates the licensing tests of the telecommunications organisations. The chip can be installed with minor modifications in existing systems, and is supplied in two types of package: the PLCC-44 and a 64-pin quad flatpack. The reduced height of this flatpack variant makes it ideal for use in lap top computers.

The PSB 2186 is a variant of the PEB 2086, optimised for telephone applications. This has resulted in a smaller package with 28 pins and consequently, lower prices. This, together with the already introduced ARCOFI-SP chip (codec/filter chip, PSB 2165), means that the price of ISDN telephones can now be reduced drastically.

For further details circle 272 on the reader service coupon or contact Siemens Electronics Components Department, 544 Church Street, Richmond 3121; phone (03) 420 7345.

## Microwave power transistors

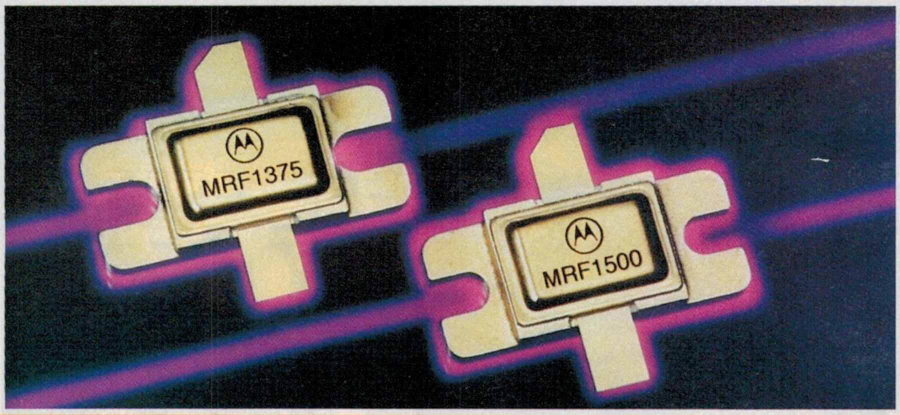
Two medium pulse width, short duty cycle microwave power transistors have been added to Motorola's portfolio. The MRF1375 and MRF1500 deliver 375 and 500 watts of output power respectively, and are intended as replacements for the Acrian DME1375 and DME1500 devices, which are no longer available.

Applications for these microwave power transistors include common base amplifiers in systems such as distance measuring equipment transmitters. They can also be used in radar, comercial location and information systems such as TACAN and IFF.

The MRF1375 and MRF1500 are capable of providing over 5dB gain, operate from a 50V supply, and can handle 10us pulses at a 1% duty cycle.

These devices are intended for operation in the 1025 and 1150MHz frequency range.

For further information circle 271 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.




## Power supply starts from 1.8V

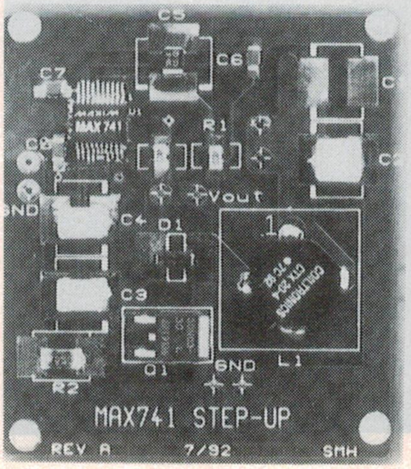
The Maxim MAX741 switch-mode power supply starts up from just 1.8V and draws only 1.6mA of quiescent current. It operates with typical efficiencies of 85% and draws just 50uA in shutdown.

This highly versatile pulse-width modulated controller can be configured as a step-up, step-down or inverting DC-DC converter, and has features that allow it to fit into battery-operated and portable applications having difficult requirements.

The MAX741U step-up converter gives high output currents from low input voltages. Applications include delivering 1A at 5V to disk drives in 3V-only systems, powering palmtop computers with 5V at 500mA from 3V battery inputs, and using the SYNC input to synchronise the oscillator and deliver clean power to cellular phone transmitter sections.

The MAX741D step-down converter features low dropout voltage, high efficiency, and excellent response to load transients due to its current-mode sensing. In a notebook computer, the MAX741D delivers 1.5A of 5V or 3.3V, with 90% efficiency and less than 1V of input-output differential. It reduces the number of batteries required in high power portable equipment.

The MAX741N inverting power supply delivers high currents of negative voltages without requiring a transformer. A typical application supplies 1A at -5.2V to drive high speed ECL gates.




The MAX741 includes many protection features such as cycle-by-cycle current limiting, adjustable soft start, and adjustable undervoltage lockout. Also, push-pull outputs can be configured to drive a transformer if isolation is required.

For further information circle 273 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

## Power MOSFET has low on-resistance

Siliconix has released a new 60V, 60A power MOSFET, which it claims offers the lowest on-resistance available to date, in a TO-220 package. Built with Siliconix SMOS 2.5 technology, which packs 2.5 million transistor cells per square inch of silicon, the SMP60N06-18 is specified with a maximum on-resistance of just 18 milliohms. Thus it offers greater efficiency and performance for battery operated

designs, such as variable speed controls used in rechargeable electric hand tools.

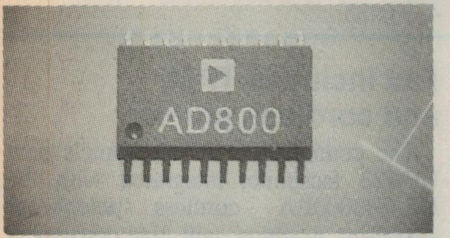
The low on-resistance of the new device brings specified benefits to battery powered designs. It generates less heat, which improves the efficiency of the design and increases battery life. The low conduction losses allow smaller heatsinks to be used, thereby reducing the size of the end product.

In some cases, where designers have been paralleling MOSFETs to reduce on-resistance, one SMP60N06-18 may be used to replace two power MOSFETs with higher on-resistance ratings. Also the low gate charge of the SMP60N06-18 (85nC total charge for full turn-on) simplifies drive circuitry, further reducing component count and space requirements.

For variable speed motor controls, the low on-resistance allows higher maximum torque and higher top speeds. The SMP60N06-18 is specified for diode commutation ruggedness, an essential feature for motor control circuits which eliminates the need for external diodes.

For further information circle 275 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766 fax (02) 647 1545.

## 155Mbps clock recovery chip




Designed to provide critical clock recovery and retiming at 155.52 megabits/second, Analog Devices' AD802-155 requires no external crystal and is housed in a 20-pin SOIC package — one half or less the size of competitive devices. The silicon IC is used in the receiver circuit of a datacomm link. It recovers the embedded clocking information from the data stream, then generates retimed data and clock.

Applications include fibre-optic receiver circuits for SONET/SDH (synchronous optical network) system terminals and related test equipment. The AD802-155 is the first member of a family of similar ICs designed for different standard data bit rates.

Unlike existing solutions, which use hybrid circuitry and costly surface acoustic wave filters, the AD802-155 requires just an external capacitor for operation. It features frequency/phase lock architecture, automatically using frequency lock for coarse acquisition and tracking (especially important when the signal is interrupted), shifting to phase lock for continuous close-in, low-jitter tracking.

The device maintains lock through a transitionless data run of up to 240 bits. The AD802 tracks the SONET OC3 standard mask for jitter tolerance, and provides a frequency acquisition indicator signal. Jitter bandwidth is 130kHz.

For further information circle 280 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 830 0970.

## Noise diodes

Alpha Industries has recently launched its new Noise Diode product line which generates white noise from 1MHz to 18GHz. These diffused junction silicon dioxide passivated diodes generate white noise when biased into avalanche breakdown. Their effective noise ratio (output) of 30dB typical (-144dB/Hz) is high enough to use directly, or with relatively high noise amplification.

They are ideal for application in BITE systems for radar, telecommunications and satellite receivers. They may also be used for calibrated noise sources for noise figure measurements.

Features include: passivated MESA fabrication for high reliability; available in chip form and various metal, ceramic, glass and stripline packages; and a cutoff frequency to 21GHz.

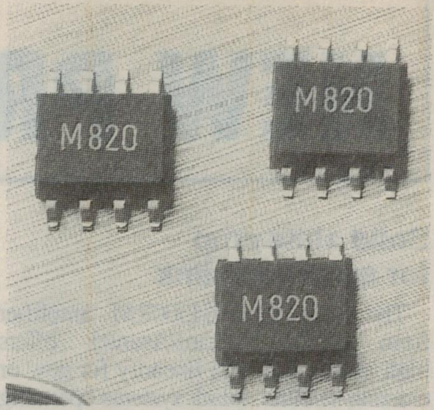
For further information circle 277 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999, fax 418 6550.

## Double balanced mixer

The HP/Avantek IAM-82008 double-balanced active mixer can be used for applications such as downconverters, upconverters, frequency doublers, transition detectors, phase detectors and modulators/demodulators.

The IAM series of Gilbert multiplier-based frequency converters is fabricated using HP's 10GHz $f_T$, 26GHz $f_{MAX}$ ISOSAT silicon bipolar process technology. The IAM-82008 has RF and LO performance to 5GHz, and IF gain from DC to beyond 2GHz. Improvements over the previously introduced IAM-81008 include a higher power output, better frequency response, and wider dynamic range.

Applications for the IAM-82008 include cellular and cordless phones; GPS receivers; fibre-optic receivers, e.g., synchronous optical network (SONET); microwave distribution systems; unlicensed spread spectrum (0.9, 2.4GHz) such as voice and data transmission; and any other communications transmitter/receivers. An IAM-82008 design needs fewer components, in comparison with a discrete solution that uses diodes. Additionally, the mixer requires fewer external components since it has 50 ohm terminations which eliminate the need for external matching.




For further information circle 278 on the reader service coupon or contact VSI Promark Electronics, 16 Dickson Avenue, Artarmon 2064; phone (02) 439 4655.

## Fast 1Mb static RAM

Motorola has 1-megabit application-specific fast static RAMs ready for sampling which, it says are 'fast enough for computer systems still on the drawing board'. The wide-word MCM67618, 64K x 18 BiCMOS fast static RAM (FSRAM) family includes members specifically designed to provide the no wait-state secondary cache for the next generation of RISC and CISC microprocessors.

With a desktop system running at over 60MHz, secondary cache chips with the required interface logic integrated on-board offer several advantages over standard fast statics.

The designer has a chip tailored for a specific MPU, which greatly simplifies system timing requirements. Also, by using highly integrated devices, fewer chips are needed for the optimum memory solution, saving board space and reducing power consumption.

All members of the Motorola MCM67-618 64K x 18 static RAM family are manufactured in 0.8 micron high performance silicon-gate BiCMOS technology. Each is 3.3V I/O compatible with high drive capabilities. Active supply current (Icca) for each device is 360mA. Active standby current (Isb1) is 50mA, while CMOS standby (Isb2) is 12mA.

For further information circle 281 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711. ❖

# NEW PRODUCTS

## Solid state amp for satellite uplink

The new AWP-64500RM amplifier from Hewlett-Packard/Avantek offers high power and high linearity for new or existing satellite uplink systems operating in the 5.925 to 6.425GHz band.

The latest rack-mounted amplifier is capable of providing over 45W (+46.5dBm) of saturated output power, and offers good linearity to within a few dB of saturation. Its high third-order intercept point (+53dBm minimum at a total output power of +40dBm) provides the low intermodulation distortion required for a variety of single-sideband AM, digital, and multi-channel modulation schemes typically used in satellite uplink transmitters.

The amplifier features 65dB minimum gain, and is easily adjusted to vary the gain continuously over a minimum range of 10dB. The higher gain allows the operator to minimise the pre-amplification required. Thus, lower power preamps can be used.


The ARS-64500RM system model combines two AWP-64500RM amplifiers with the ASW-64000RM automatic switch assembly. In the redundant configuration, the automatic switch assembly monitors the fault status of each amplifier. The switch selects one of the two amplifiers as online and the other as the hot standby.

The signal through the standby amplifier is fed into a high power termination. If a failure is detected in the online amplifier, and the switch is set in the automatic mode, the signal path will automatically be switched to the standby amplifier.

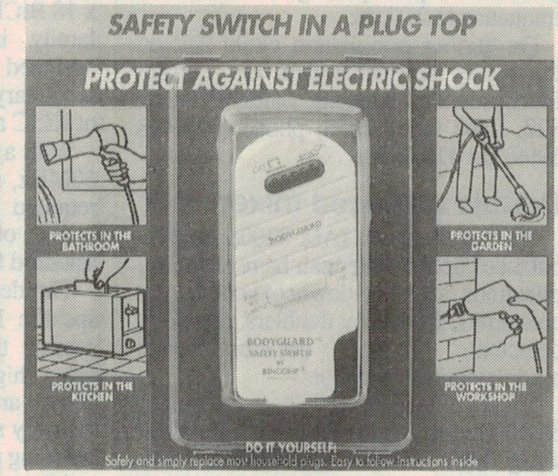
The AWP-645000RM protection failures include amplifier and fan failure alarms, thermal protection, and an automatic shutdown function in case of failure.

For further information circle 242 on the reader service coupon or contact VSI Promark Electronics, 16 Dickson Avenue, Artarmon 2064; phone (02) 439 4655, fax 439 6435.

## RingGrip safety device

Lives can be saved within 4/100ths of a second by a new electrical home safety device, RingGrip's Bodyguard RCD (residual current device).

Where Bodyguard detects a dangerous earth fault, it will shut power off within 40 milliseconds — faster than a human heart beat. Designed to plug into power points, it can be used with most household appliances, from hairdryers to toasters and power tools.




The compact Bodyguard uses state of the art micro technology to provide the best possible protection against electrocution without the bulk of other safety switches.

It operates by constantly monitoring the current flowing through the active and neutral wires, and 'trips' if an imbalance occurs by current leakage to earth (possibly via the human body).

An added feature of Bodyguard Power Boards is the built-in overload device. This device is designed to cut off power if an appliance draws too much current. All products have been fully tested and approved by Australian Electrical Authorities and come with a full 12 month warranty. Bodyguard starts at a recommended retail price of around $29.95.

For further information circle 243 on the reader service coupon or contact RingGrip, 333 Frankston-Dandenong Road, Dandenong 3175; phone (03) 212 1333.

## Fax includes TAM and cordless phone

The combination of Panasonic's new UF-123 facsimile, integrated with the KX-T43000BA cordless telephone/answering machine, will give consumers the option of controlling their fax and answering machine via a remote control handset, as well as receiving telephone calls anywhere within a 300-metre radius of their office.

This means people don't need to be tied to their desks to activate their fax machines, should they be using a shared line for both phone and fax.

Because the UF-123 eliminates the need for a second telephone line, should the user hear a fax tone when he or she answers the cordless handset, it is simply a matter of pressing the 'star' button twice and the fax machine is activated via remote control.

The recommended retail price for the UF-123 personal/small business fax is $999, and for the KX-T43000BA, $559.

For further information circle 244 on the reader service coupon or contact Panasonic Australia, 1 Garigal Road, Belrose 2065; phone (02) 986 7500.

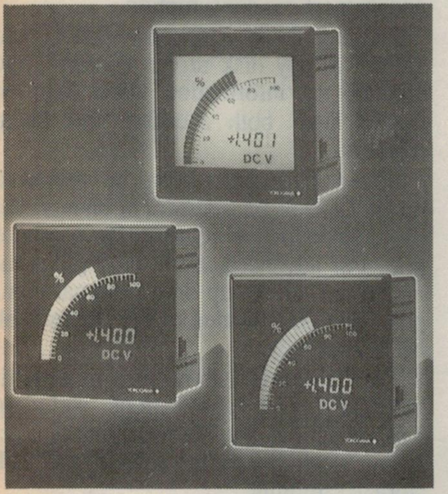
## Hybrid panel meters

Yokogawa has released a range of low cost, high performance hybrid panel meters, with the convenience of an analog bar graph and the accuracy of digital display.

An LCD or yellow/green LED display makes it ideal for test benches, switch boards and control panels.

High contrast and wide viewing techniques have been incorporated to make the viewing angle easier, even from difficult or remote positions. Viewing angles of 40° left and right, 20° above and 40° below have been achieved.

There is a large range of inputs available, including DC volts and amps, AC volts and amps, and 4 - 20mA. Bar graph deflection in both directions has been accomplished. To convert the analog signal for indication the digital meter uses dual slope integration, and the bar graph uses sequential comparison.




For further information circle 241 on the reader service coupon or contact Yokogawa Australia, Centrecourt D3, 25-27 Paul Street North, North Ryde 2113; phone (02) 805 0699.

## Audio delay recorder

The new Solid State Audio Delay Recorder by Questech is a tool for recording, playing, synchronising and storing audio, and is being suplied in large volumes in the UK to accompany digital video frame synchronisers. It has analog and digital inputs and outputs and can convert between the two simultaneously. The machine has a DSP facility, which enables it to do simple editing functions such as crossfades, loop, pans and fades and allows the user to jog through the store at variable speed. A SCSI interface is provided for storing audio on an external disk.

The SSAR has three modes of operation. It can add a delay to an audio path, which can be specified in seconds, frames and milliseconds. This may be used to compensate for delays in other signal paths such as video through a synchroniser. The delay may be set to a fixed time value, or made to track the delay of another device.

The unit can also convert analog audio to AES/EBU digital audio, and vice versa, simultaneously. The digital output may be genlocked to the digital input or the machine can generate a digital output on its own. The third record and playback mode is intended for post production applications. Audio may be recorded into the SSAR with timecode.

It is possible to record several clips and assign names to them. Clips already in the store will not be overwritten by subsequent recording.

The material in the store may be manipulated with simple editing functions. The SSAR can play back recorded material synchronised to incoming timecode so that audio is locked to the video. It is possible to crossfade between live and recorded audio and both may be slipped relative to video.

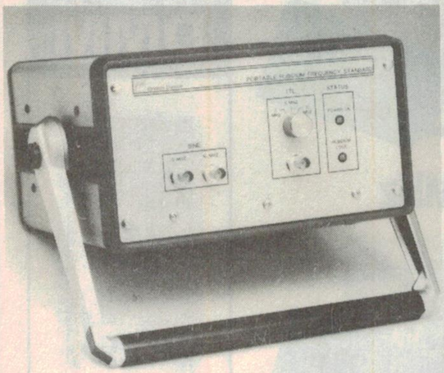
For further information circle 248 on the reader service coupon or contact Mastatek, 4/265 Williamstown Road, Port Melbourne 3207; phone (03) 646 5477, fax 646 2730.

## Frequency standard

The Efratrom Division of Ball Corporation has introduced a modest cost, portable, mains powered frequency standard in a rugged compact bench case with a carrying handle.

Based on the Efratrom FPS-C rubidium oscillator, with buffer amplifier and regulated power supply, the PRFS provides three buffered outputs at the front panel, i.e., one 10MHz sine wave, one 5MHz sine wave and one switchable 1.5 or 10MHz TTL. The outputs are disabled during warm up or if the rubidium oscillator loses lock.

The instrument provides an ultra stable frequency with excellent short and long term stability.



For further information circle 245 on the reader service coupon or contact The Dindima Group, PO Box 106, Vermont 3133; phone (03) 873 4455, fax 873 4749.

## Higher values in ceramic capacitors

Kemet has developed a new ceramic dielectric formulation that allows it to introduce new higher capacitance ratings in its 50V COG ceramic chips. The new material will approximately double the available capacitance ratings in each case size.

The development allows it to add many new high demand values to its COG listings, consequently case size 0805 has now a new extended maximum capacitance of 1500pF, the 1206 size 4700pF and the 1210 case size 8200pF.

For further information circle 246 on the reader service coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St Peters 2044; phone (02) 516 3855, fax 517 1189.

## Portable gas monitor

A new portable toxic gas and vapour monitor, the MSA Baseline GasCorder can be used for portable gas monitoring and analysis in a wide range of survey applications.

It is available with either a photoionisation Detector (PID), suitable for chemical gases, or a flame-ionisation detector (FID) sensitive to organic vapours. Its LCD display screen is easy to read, and gives both real time and historical data, detector status, battery life, disk capacity and support gas consumption.

The monitor is equipped with a rugged 1.4MB floppy disk driver to store large amounts of information which can be tagged with both location and event markers.

Stored information can be reviewed on the LCD display screen, or on a printer by connection to GasCorder's printer port. For advanced users, multiple parameters can be set up on a personal computer and downloaded to the floppy disk before a survey.

The GasCorder can be used in a multitude of survey applications including leak detection, arson investigation, hazardous waste site testing and soil and tank storage sampling.

For further information circle 246 on

the reader service coupon or contact MSA Australia, 137 Gilba Road, Girraween 2145; phone (02) 688 0333.

## Trunked portable radio

The Kyodo KG109 trunked portable radio has been released for use with MPT1327 trunked networks.

MPT1327 is the internationally popular trunking system which gives users access to more channels quicker than conventional repeater systems. Trunking operates using similar technology to that used with Cellular Telephones, but uses two-way radios instead of telephones. Thus, users get a better radio coverage with quicker access to the person or persons they are calling at a similar cost to conventional radio systems.

The KG109T portable is available as a VHF or as a UHF FM synthesised portable radio, which features microprocessor controlled electronics, surface mounting technology (SMT), and excellent on-air performance. It will operate on any of the usual 80, 150, or 400MHz frequency bands.

The radio complies with the internationally popular MPT1327/1343 standard. It features mobile to mobile, mobile to group, and mobile to PSTN communications. Other functions supported are: Interfleet calling, emergency calls, priority calls, short data messaging, unprescribed data calls, status messages (two of which may be programmed with a text message), group calling (broadcast and conference), and PMR conventional mode for radio testing.

The KG109T has a 20-character alphanumeric LCD display which is used to display numbers, preprogrammed text messages, and received alphanumeric message. The ability to send or receive 20 character alphanumeric messages is a special feature.

For further information circle 260 on the reader service coupon or contact Imark Communications, 2/75 Mark Street, North Melbourne 3051; phone (03) 329 5433, fax (03) 328 4431.

Special Feature:

# The latest in SMT and soldering products

## SMT inductors

Cambion of Sheffield in the UK, has released the 553-1053 series of surface mount inductors, especially relevant to the defence, communications and aerospace industries where these components are frequently used and high quality and reliability are particularly important.

The fixed radio frequency inductors are available with values between 0.1uH and 1000uH in the E12 series and have approval as defined by BS2488 1966 (IEC63). The 555-1053 range has a footprint of 3.2 x 4.0mm and, depending on the inductance, a height of either 2.4mm or 3.4mm. The inductors are encased in moulded epoxy on a ceramic base, for high reliability. Cambion's full range of surface mount inductors also includes the 555-1083 range of micro inductances (0.010 to 0.082uH) and the 556-052 range of variable inductors (0.06-0.13uH to 450-2000uH).

For further information circle 201 on the reader service coupon or contact Electronic Development Sales, 11-13 Orion Road, Lane Cove 2066; phone (02) 418 6999, fax 418 6550.

## Compact, low cost soldering station

Dick Smith Electronics has released a new low cost soldering station, featuring a temperature-controlled miniature precision iron. The T-1900 also features a built-in transformer, power indicator, iron holder and tip cleaning sponge.

Imbedded in the tip of the T-1900's lightweight iron is a burnout-proof ceramic heater, having a positive temperature coefficient (PTC). This provides accurate temperature control (310°C +/-10%), high reliability (no switching is involved) and fast response to temperature drop from thermal loading. The controlled tip temperature also results in longer tip life. Typically the iron tip is claimed to reach its operating temperature in approximately 45 seconds from turn-on. The iron's tip, heating element and barrel are a single assembly, and are replaced as a unit. Replacement barrel assemblies are available from DSE as Cat. No. T-1951. The handle of the iron is fitted with a sliding on/off switch, to allow it to be turned off if soldering is not to be performed for long periods.

The iron's low voltage cable plugs into the front of the base unit, via a special connector. This features a LED indicator to show when low-voltage power is present. The iron holder is attached to the rear of the base, while the cleaning sponge is fitted into a moulded recess at the top.

We were able to try out a sample T-1900 soldering station ourselves, by courtesy of DSE, and found that it performed well in a wide range of soldering jobs involving modern miniature components.

The control of tip temperature while the iron is idling seemed to be comfortably within the +/-10% rating, which should extend the useful life of the tip significantly over an uncontrolled iron — and also ensure that delicate components are not damaged by heat surge during soldering itself.

This is also assisted by the tip's relatively small mass, giving it limited thermal capacity.

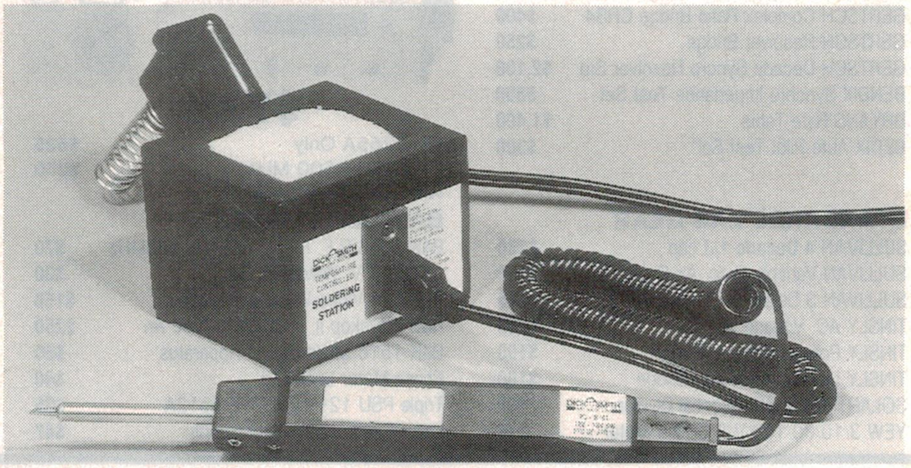
We couldn't actually achieve the claimed 45-second warmup time, but this may have been due to the relatively large mass and thermal capacity of our measuring thermocouples. The iron only has a 6W heater element, after all, and the additional thermal capacity would inevitably slow its warmup characteristic. The best we could achieve with one of the thermocouples attached to the tip was about 100 seconds — but in typical use, the iron could be used for soldering component leads within about 55-60 seconds at most (from near ambient).

Although it's only a very light-duty iron, we did find that with care and patience it could also be used for jobs needing a little more heat — such as soldering component leads to a sheet of unetched copper laminate 'ground plane'.

The transformer/base unit seems well made, although it's of moulded plastic and a little light in weight — the 'spring' in the iron's curly cord can cause it to slide along the bench when you try to extend the cord.

The cleaning sponge seems to be cemented into the top recess, too, so you have to bring water to the station when you want to re-moisten it, rather than take the sponge to the nearest tap. The iron holder is well designed, though, and locates the iron conveniently and safely — provided of course that the station doesn't slide around so the dissipator spring touches something it shouldn't.

All in all, though, the T-1900 seems a nice little soldering station and one that is well suited for much of today's electronics work. For the quoted price of



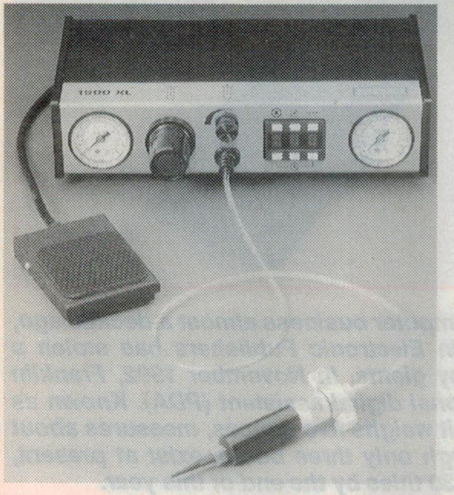
$49.95, which is well below other temperature-controlled stations, it's also excellent value for money.

By the way the T-1951 replacement iron barrel assemblies are available at a very reasonable $9.95. Both should be available at all Dick Smith Electronics retail outlets. (J.R.)

## Pulsed air dispenser

The new EFD model 1500XL dispenser incorporates advanced microprocessor circuitry to provide real-time display for pulsed air dispensing of all types of assembly fluids.

With the 1500XL's microprocessor time control, real-time pulse cycles can be entered, increased or decreased by push button. During the pulse cycle, the display zeros out and time counts up to preset time. Real-time digital display of 0.001 to 99.9 seconds allows exact setup for critical deposits.



The 'teach' function for easy programming allows the operator to establish the time by pressing the foot pedal to dispense the required deposit size. The microprocessor then stores this time in memory and accurately repeats this deposit — dot-to-dot, fill-to-fill. The 1500XL, with 0.00005 second repeatability, allows the operator to make close tolerance, repetitive deposits. Assembly time and fluid usage are significantly reduced. The dispenser incorporates an I/O interface for a 5.24V DC start signal, with 'cycle complete' feedback signal for closed loop process control.

For further information circle 202 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999, fax (02) 418 6550.

## SMD ceramic resonators

Murata Manufacturing has released an SMD range of the popular Ceramic Resonators, which is suitable for crystal replacement in a wide range of applications. The advance in integrated technology has expanded the field applications of the SMD ceramic resonator from frequencies 2.00MHz to 32.00MHz.

Features of the SMD ceramic resonators are the miniature size and low profile, along with tape/reel packaging for automatic placing. The CSAC series is also suitable for reflow soldering and has excellent temperature characteristics. The frequency range is covered by three types MGCM (2.00 to 6.00MHz), MBT (6.01 to 13.0MHz) and MX (15.00 to 32.00MHz). The CSAC series is suitable for clock generators for microcomputers, various remote control systems and automotive electronics. The oscillating frequency initial tolerance is +/-0.5% over the frequency range and 0.3% to 0.5% for temperature stability and ageing.

For further information circle 204 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766, fax (02) 647 1545.

## Dual function soldering system

OK Industries has released the new SA-2000 series of dual soldering systems which enable simultaneous operation of any two specialised soldering handpieces. A variety of tasks can be performed including: SMT component removal (SAI-644 SMTweezer), standard and high thermal demand soldering 9SAI-690 macro iron) and fine SMT touch up soldering (SAI-640 micro iron). Additionally, the SAI-690X and SAX-640X incorporate a fume extraction assembly.

The SA-2000 conforms to US MIL-STD-1686A and MIL-STD-2000A using static dissipative materials and incorporating zero voltage switching, has less than 2.0mV AC leakage, <5.0 ohms tip to ground resistance and ideal temperature repeatability better than +/-5°C. An expanded tip range includes tips for through-hole, SMT chip, SOIC, PLCC and QFP soldering applications.

For further information circle 203 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999, fax (02) 418 6550. ❖

# Silicon Valley NEWSLETTER

## Sematech achieves 0.35-micron chip

Having already retaken the lead from Japan in worldwide market share, the US semiconductor equipment industry has achieved another critical milestone. For the first time in more than a decade, US semiconductor companies are able to build leading-edge wafer fabs furnished exclusively with American-made equipment.

Sematech has announced it has achieved its five year objective of helping US chip equipment makers build the necessary tools to enable the 11 members of the Sematech consortium to produce ICs that are technologically superior to any competing Japanese or other foreign components.

Sematech said companies like Intel, Motorola, IBM and others will be able to produce advanced microprocessors and memory chips using an all-US 0.35 micron process technology. (Even Intel's upcoming 586 Pentium chip, with three million transistors on its surface, is carved out in 0.6 micron technology). At 0.35 microns, companies will be able to produce chips with up to 100 million transistors and operating at speeds of 100 - 200MHz.

Both industry executives and market analysts were quick to hail the Sematech announcement. All agreed the credit for the remarkable comeback of the US semiconductor equipment and industry belongs to Sematech.

Sematech was formed by a dozen or so of the largest US chip makers, who in 1987 pledged to invest a combined US$100 million a year for five years in the consortium.

The US government, through the DARPA (Defense Advanced Research Projects Agency) arm of the Pentagon, agreed to match the industry's subsidies with another US$100 million.

Initially, Sematech focused on developing the necessary process technology and equipment to build a 160-megabit or 64-megabit SRAM pilot production line. But the orientation quickly shifted towards being a support group for the then-struggling US semiconductor equipment industry.

Sematech entered into scores of joint R&D projects with dozens of US equipment and materials firms, to help develop next generation versions of their product lines.

The effort has paid off in a big way. Because their equipment is now rated equal or better than similar Japanese products, most US semiconductor houses have already begun to favour US equipment companies when retooling existing plants or when building new facilities.

"Our state of the art purchases favour American companies that seem to have the advantage. It is very encouraging," said Intel spokesman Howard High.

Until Sematech, the relationship between US chip makers and equipment makers had been very adversarial. "That has changed. Under Sematech, they have begun to work together, recognising their common interests," said Peggy Wood at Dataquest.


***After being forced out of the personal computer business almost a decade ago, the small New Jersey company Franklin Electronic Publishers has stolen a march on Apple and other Silicon Valley giants. In November 1992, Franklin launched the world's first portable personal digital assistant (PDA). Known as the Franklin Digital Book System (DBS), it weighs five ounces, measures about 3" x 6" and costs only US$199. Although only three books exist at present, Franklin expects to be selling more than 30 titles by the end of this year.***

## FCC may delay HDTV decision

The US Federal Communications Commission is facing a difficult task selecting the winning design of a US HDTV standard, as all six entries have proven to meet the FCC's requirements and none of the options has emerged with a clear advantage over the others.

An FCC panel has been conducting a week-long series of meetings and seminars to determine whether the FCC should add new stipulations to its HDTV contest, and send bidders back to the drawing board to come up with further improvements.

According to television industry reports, all six entries, during 18 months of laboratory testing, have shown they will bring theatre quality picture clarity to home television sets. But the tests have also shown that each entry has one or

more shortcomings, complicating the decision process.

The FCC is under a self-imposed deadline to announce the US standard before the end of this year. Additional testing would almost certainly cause the FCC to delay its decision into 1994. But industry executives said the FCC shouldn't worry about some additional delay, as the decision is simply too important and should not be rushed.

"We're going to live with this standard for decades. To say that we can't take two or three more months for testing doesn't make any sense," said AT&T's Robert Graves.

Among those supporting additional testing and development is the powerful National Association of Broadcasters. Many of the small local TV stations are worried about having to invest heavily in new HDTV broadcast equipment, for what is likely to be a very small percentage of viewers — as HDTV sets will remain too expensive for the masses.

## NeXT drops hardware

After struggling for almost four years to become a major vendor of advanced graphics-oriented workstations, NeXT Computer has dumped the hardware side of its business and intends to become a software-only house instead.

Steve Jobs said his company has informed some 500 employees in manufacturing related positions they are being laid off as the company's marketing focus is shifting, towards making its advanced object-oriented-based NextStep operating system software a standard on many different types of technical and business computers.

"There is some sadness in this, but everyone we've talked to, including customers and analysts, said we are doing exactly the right thing," Jobs said.

To date, NeXT has shipped some 50,000 of its workstations — about six days worth of shipments at Jobs' former company, Apple Computer. NeXT will continue to make some workstations through May to fulfil contractual obligations.

One close observer of NeXT was quick to put the blame for the company's failure in the market squarely on Jobs's shoulders. Randall Stross, a professor at San Jose State University whose book on the history of NeXT is due out later this year, said NeXT is a company "pursuing a doomed strategy based on Steve Jobs's desire to recapture a glorious past, but a past that just could not be reproduced."

Stross said key executives at NeXT had suggested a software-only strategy years ago. But their suggestions had fallen on deaf ears as Jobs insisted on bringing hardware products to market.

"It is not just the big dinosaur companies like IBM and DEC that are slow to react, but any company that thinks it knows better than the marketplace does."

As part of the restructuring, NeXT said it has sold its hardware design centre to Canon, its long-time Japanese partner. The company is also trying to sell the state of the art manufacturing facility in Fremont. Hewlett-Packard is rumoured to be interested in the facility.

## US semi market breaks $1 billion

The US semiconductor market started 1993 where it left off in 1992 — setting records!

Chip orders zoomed further upwards, breaking the US$2 billion monthly barrier for the first time and sending the closely watched book-to-bill ratio to 1.19, its highest level in four years.

At the January order rate, the US market is running considerably ahead of order activity in the Japanese market. As recent as 1991, the gap between the US and Japanese market was several billion dollars and growing. Many thought the US would never be able to catch up to its Japanese rival.

## Video-on-demand over copper lines

In a deal that could revolutionise the way people use their television, AT&T and Compression Labs of San Jose have announced they will jointly develop a television-top device that will allow consumers to order rental movies from a central digital library and have them sent into their TV set over conventional copper telephone wires.

To date, the maximum speed with which data can be transmitted over conventional telephone lines is about 15,000 bits per second, a rate at which it takes four minutes to send a single motion picture frame. But using Compression Labs' data compression technology and an advanced AT&T transmission technology that will send up to 1.5Mbps of data over existing telephone lines, consumers will be able to receive movies of VCR-like viewing quality.

Under the terms of the deal, Compression Labs will build the video receiver that will sit atop a TV set, connecting to a nearby telephone outlet on one side and to a TV set on the other side.

The receiver will be built around a VLSI chip set. The unit will integrate AT&T Paradise's 'Asymmetrical Digital Subscriber Line' (ADSL) technology, and also the high speed 'carrierless amplitude/phase modulation' (CAP) transmission technology, as well as Compression Labs' Compressed Digital Video technology.

"This represents an important milestone for the telephone companies in the emerging visual communications marketplace. I envision the telcos could provide commercial services as early as 1994," commented Joe Crupi, AT&T vice president and general manager of its Paradise Advanced Transmission Technologies Division.

## Giants form comms alliance

Six giant computer and electronics conglomerates on three continents have formed an alliance to develop and push a new standard for a new generation of 'personal communicator' devices that perform telephone, E-mail, fax and portable computer functions in devices as small as wallet-size calculators.

The alliance is formed around General Magic, a company spun off last year by Apple Computer, which has been working secretly on developing a personal communicator.

The six companies that have joined Apple in the alliance are Sony, Motorola, Philips Consumer Electronics, Matsushita, and AT&T.

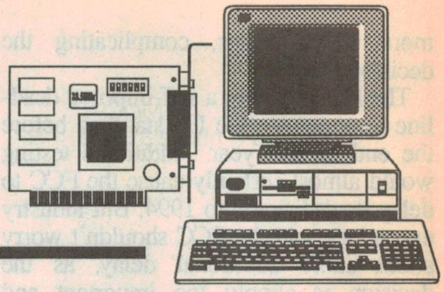
Personal communicators, as envisioned by Apple and others, are small handheld devices which allow people to communicate by voice, fax, E-mail and sending and receiving computer data. They will also allow users to scribble notes on a small electronic screen which doubles as a pen-based computer display.

The communicators operate over radio waves. They will incorporate personal calendar functions, keep grocery and other shipping lists, maintain a phone and address listing, and a host of other functions.

The intent of the alliance is to quickly develop a standard supported by a number of what are expected to become some of the new industry's biggest players. Adopting such a standard at such an embyonic stage will ensure that the future market will not fragment along several different, incompatible paths. It will make it easier for start-up companies to develop products, both software and hardware products, and also ensure that users with a communicator made by Apple will be able to communicate easily with a similar device from AT&T.

Already several communicator products have emerged in the market, most notably a device from EO. IBM has also been working on a wireless personal communicator. ❖

# Computer News and New Products



## LEAP 4.5

Audio Teknology Incorporated have released the latest version of their powerful Loudspeaker Enclosure Analysis Program (LEAP) for IBM-compatible PCs. LEAP 4.5 now offers both a 500-page reference manual and 450-page applications manual, plus a host of revisions and upgrades to the software itself.

These include more elaborate definitions of passive network components, new infinite baffle and free-air models for enclosure simulations, enhanced features for all of LEAP's utility functions, a cable inductance and resistance calculator, an automatic screen saver, and improvements to editing operations.

Existing LEAP users will be pleased to hear of the arrival of the long-awaited reference manual, while the new applications manual should suit inexperienced users in particular, since it offers practical design examples covering all of LEAP's major features.

As in previous versions, LEAP 4.5 can be purchased as a number of individually priced 'modules', depending upon a customer's requirements. With this system, you only pay for the features that suit your current requirements, and these sections of the software are 'activated' accordingly — and if your needs change at a later date, more modules can be purchased and activated, as required.

With current exchange rates, the complete LEAP 4.5 system is priced at $1810, an upgrade from version 3.XX is $1515, and the upgrade from version 4.XX costs $399.

For further information on LEAP 4.5's features and prices for its individual modules, contact ME Technologies, PO Box 50, Dyers Crossing, NSW 2429; phone (065) 50 2254 or fax (065) 50 2341.

## 286 CPU 'ROM disk'

A new version of the popular PCA-6126D, 16MHz 80286 CPU card can now be configured for up to 1.44MB of ROM disk by using three 512k x 8-bit EPROMs.

The PCA-6126D features the functions of CPU, RAM, disk controller, serial/parallel ports, ROM disk, watchdog timer and maths co-processing capability, all packaged in one 6-layer board.

The card can be plugged into the passive backplane of the 12-slot IPC-610 industrial rack mount chassis, or into the 6-slot IPC-6706 card cage, converting either into an IBM PC/AT compatible system.

The card uses CMOS devices for a low power consumption of +5V at 1.5A, with a wide operating temperature range of 0 to 60°C. It has a built-in IDE (AT-bus) hard disk interface to support two hard drivers and a built-in floppy drive controller to support two floppy drives. The ROM disk emulates up to 1.44MB of write-protected disk in drive A, and the watchdog timer ensures that the CPU is reset should program executions fail in a stand-alone or unmanned environment. The onboard RAM is configured as two banks, each with two SIMM sockets. Each socket accepts one 1M or 256K SIMM. Total onboard memory can be 512K, 1M, 2M or 4M bytes.

The PCA-6126D all-in-one 286 CPU card markets at a list price of $670.00.

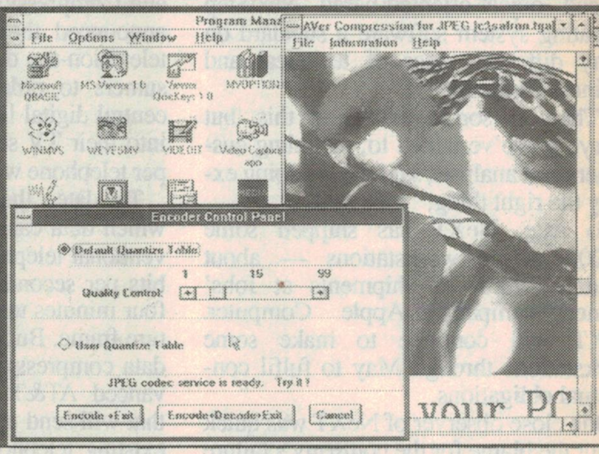
## Still-image compression

The AVer JPEG card is a low cost hardware and software solution for still-image compressing and archiving. It comes with both DOS and MS Windows software and can instantly compress images by varying factors with negligible deterioration.

The AVer JPEG card has a sophisticated compression factor control ranging from 1 to 99. This can be either slide-bar controlled or you can use the Quantize Table for greater control of the compression factor.

The card can compress TGA, BMP and TIF files to standard JPEG format. At the default compression factor of 15, a 1MB BMP file will compress to approximately 40kb in less than three seconds, running on a 386 at 33MHz. The size of compressed JPEG files also makes them ideal for image transmission over a modem or communication line.

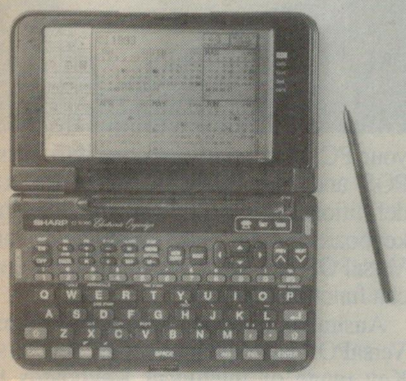
System requirements are a 386 (min) with 2MB RAM and MS Windows. The card is priced at $590, including tax.




For further information circle 161 on the reader service coupon or contact Lako Vision, 1/45 Wellington Street, Windsor 3181; phone (03) 525 2788.

For further information circle 162 on the reader service coupon or contact Priority Electronics, 23 Melrose Street, Sandringham 3191; phone (03) 521 0266, fax 521 0356.

## Organiser uses touch technology



Sharp's latest and most advanced Electronic Organiser uses a radical new technology with a 'touch sensitive' screen. With the aid of a special pen, functions can be quickly and easily performed, including the ability to draw directly on the screen.

A Graphical User Interface (GUI) replaces certain keyboard commands with identifiable visual symbols, or icons. These need only be touched to put an action into effect, say filing or retrieval. Using the special Sharp stylus (or even your finger), the functions and menu on the screen can be selected by light touch. The stylus can also be used to highlight text for changing, moving or filing.

Along with its touch feature, the IQ9000 is a powerful handheld portable Word Processor with all the popular WP features and built-in printer drivers for a direct link with a selection of printers.

An additional feature of the IQ9000 allows data to be transferred by an infra-red port from unit to unit. This facility can be extended from a PC link or a PC printer with optional wireless interfaces.

For further information circle 165 on the reader service coupon or contact Sharp Australia, PO Box 827, Blacktown 2148; phone (02) 831 9111.

## Plug-in CPU boards

Industrial Computer Source has released its SB386G and SB436G range of plug-in CPU cards. These passive backplane CPUs are fully featured with the addition of VGA output to the standard serial, parallel, floppy and hard disk controllers. All features are jumper selectable. The complete range includes 25MHz 80386SX, 40MHz 80386DX, 33MHz 80486DX and 50MHz 80486DX2 options.

All boards include two serial ports, parallel port, IDE and floppy drive controllers, 800 x 600 SVGA controller, keyboard and speaker port, and up to 32MB onboard RAM. A socket for the optional 80387/SX, 80387 or Weitek 4167 coprocessors is available on the respective CPU cards. In addition, the SB386G board has a 32K cache, while the SB486G board has 128K cache memory.

These USA-manufactured CPU boards are designed for use in harsh environments, or in application requiring extremely high reliability. Operating environmental specifications are 0-60°C, with a mean time between failure (MTBF) rate of 63,800 hours.

For further information circle 163 on the reader service coupon or contact Interworld Electronics and Computer Industries, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 563 5011.

## AutoCAD for Windows 3.1

Autodesk has released a stand-alone version of AutoCAD for Windows 3.1. AutoCAD Release 12 has been specifically developed to make it easier to use computer-aided design (CAD) tools for the first time.

The suggested retail price of AutoCAD Release 12 for Windows is $5450. The suggested price of the optional, fully integrated solid modeller, AME Release 2.1 for Windows (the version required for use with AutoCAD Release 12 for Windows) is $700.

For further information circle 164 on the reader service coupon or contact Autodesk Australia, 9 Clifton Street, Richmond 3121; phone (03) 429 9888, fax 429 2296.

## Hayes Smartmodem

Hayes Microcomputer Products has released its Smartmodem OPTIMA 2400 (OPTIMA 24) in Australia. OPTIMA 24 recently approved by Austel, is a cost effective solution for business and personal communications that provides CCIT V.42 error control and V.42 *bis* data compression for data throughput up to 9600bps.

OPTIMA 24 supports CCIT V.22 *bis* (2400bps) and CCIT V.22 (1200bps) as well as industry standards 103 (300bps) and 212A (1200bps).

OPTIMA 24 communications asynchronously and synchronousely, as well as supporting Hayes AutoSync, a standard Smartmodem feature that obviates use of an SDLC card.

The modem comes bundled with Smartcom EZ, simple to use communications software that enables users to access

PCs and online or BBS services. Smartcom EZ provides easy-to-follow menus, phone book entry capacity to store frequently called numbers, keyboard macros and Autotype to transmit text files effortlessly.

The software provides extensive online help screens, allowing users to master computer communications quickly, without having to refer to traditional manuals and detailed documentation. In addition, the XMODEM protocol allows users to send or receive data files error-free between locations.

The RRP, excluding tax is $609.

For further information circle 168 on the reader service coupon or contact Merisel, 4 Sirius Road, Lane Cove 2066; phone (02) 882 8888.

## Double-sampling boards

Two new high speed data acquisition boards use 'recirculating flash converter' technology.

This new design samples your signal twice within 1us to achieve full 12-bit resolution. Compared to 'successive approximation' technology, this yields greater speed at a lower manufacture cost.

The FLPC 1000 is capable of 1us conversions on all 16 single-ended or eight differential channels.

A special onboard memory queue holds channel sequence and gain settings, so each channel may be independently set while running at the full 1MHz speed. The choice of 15 input ranges, unipolar, bipolar, and single-ended/- differential are all software selectable on the fly.

The FLPC 400, very similar to the FLPC 1000, offers 1MHz acquisition on a single channel, or 400kHz acquisition on up to 16 single-ended or eight differential channels.

This board is suitable as a replacement for 100kHz boards: use of a sampling rate four times greater allows oversampling and signal averaging to reduce noise and achieve a higher effective resolution.

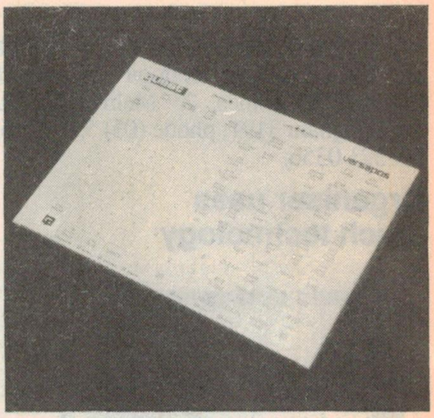
Both boards perform self-diagnostics at power-up and on command. The boards are factory calibrated, guaranteed for two years and automatic self-calibration is performed on an onboard ultra-stable reference. The onboard frequency synthesised pacer clock allows conversion rate to be set with 0.01% accuracy over a range of 1MHz to 11.6uHz.

Each board has a 64k sample memory buffer. Optional daughterboards allow this to be increased to 1M sample, allowing operation without using PC system memory. This also allows pre-trigger and post-trigger acquisition, and background acquisition while the PC is occupied with another task.

QuickLogPC, a subset of WorkBenchPC, is supplied with each FLPC board. Also included is the Analog Connection Development System, a set of routines compatible with Pascal, C, Fortran, BASIC, Assembler and Asyst. Example programs are provided in each language.

For further information circle 169 on the reader service coupon or contact Boston Technology, PO Box 1750, North Sydney 2059; phone (02) 955 4765. ❖

## Intelligent membrane keypad



Quest International Computers has released the VersaPOS Intelligent Membrane Keypad, for use with IBM PCs. The VERSAPOS ia a low cost, simple to use and completely flexible Membrane Keypad for use in Point-of-Sale, Process Control and general computer applications where easy, user-definable key definitions are required.

It provides a flat touch sensitive membrane with 120 key locations which can be assigned by a user to perform system commands or text entry, reducing complex functions down to single key operation. The keystrokes are stored internally in non-volatile memory for replay at any time.

The standard model can store up to 14,000 keystrokes across the 120 keys, while an enhanced model is capable of storing up to 30,000 keystrokes. In complex operations, such as plant control rooms, several VersaPOS Membranes can be daisy chained together, providing a very large array of key groupings.

Any normal keyboard can be plugged into VersaPOS to 'teach' it the keystrokes. No external software is required for normal operation, just plug VersaPOS into your PC, plug your keyboard into VersaPOS and start using it. When the key definitions are complete, the standard keyboard may be unplugged and VersaPOS can work alone, or both units can function together.

Australian designed and manufactured, VersaPOS is a development of the VersaKey range of Intelligent Keyboards for IBM PCs, Apple Macintosh and Wyse 60/120 terminals.

For further information circle 170 on the reader service coupon or contact Quest International Computers, 1 Hamilton Place, Mount Waverley 3149; phone (03) 807 7444, fax 807 7056.

FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...

## NEW NIMROD Gas-Powered Soldering Iron


Nimrod is a quality tool weighing only 52grams yet producing torch temperatures as high as 1300°C.

Maximum tip temperature is 400°C. It offers similar performance to an adjustable 10 to 60W iron. A single fill of gas lasts approx 1 hour. Case has window to check how much gas is left. Protective cap has built-in flint lighter.

UK designed and built to European engineering standards.

Ideal for field service technicians and sensitive circuitry (no leakage currents!)

Choice of spare screw-in tips available (no need to buy a new catalyst each time!)

Available as a soldering iron on its own for **$39.95**

Or buy the complete kit with hot knife, gas torch and hot air tip plus solder, spare flints, stand and cleaning sponge in convenient carry case measuring only 210 x 100 x 40 mm. **$74.95**

Spare tips 1, 2, 3 4mm and hot knife **$6.00**, Hot Blow & Blow Torch **$12.50**, Catalyst **$6.50**

Gas Refil 150gm **$6.95**

## Electrolube Service Aids

***Electrolube PR50 Positive Acting Photo-Resist.***

Ideal for pcb's, etching pictures onto copper plates, etc. Uses new safe, acqueous alkali developing and removing chemicals.

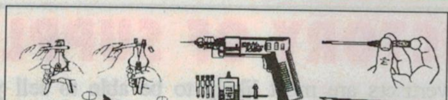
| | |
|---|---|
| RP50 Photo-Resist 200ml aerosol | $33.00 |
| RP50 Photo-Resist Developer 250ml bottle | $13.35 |

***We stock the full range of Electrolube products in sizes to suit all requirements. Call for detailed pricing***

| | |
|---|---|
| Clear Lacquer (250gm) | $13.10 |
| Freezer (550gm) | $23.80 |
| Cleaning Solvent (300gm) | $10.70 |
| Safewash 2000 (400gm) | $19.80 |
| Saferinse (400gm) | $18.10 |
| Air Duster (550gm) | $26.80 |

## TOOL BOX

If you want to do a good job, you need the right tools – and we've got 'em! Call in and check your requirements whether it's for your job or your hobby, we'll have the best quality and the best price.



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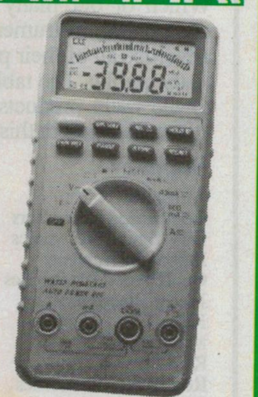


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